

GROUND WATER RECHARGE IN THE HIGH PLAINS STATES; AND DELIVERY OF WATER TO THE NORTH PLATTE IRRIGATION PROJECT

HEARING BEFORE THE SUBCOMMITTEE ON WATER AND POWER OF THE COMMITTEE ON ENERGY AND NATURAL RESOURCES UNITED STATES SENATE NINETY-EIGHTH CONGRESS

SECOND SESSION

ON

S. 1811

A BILL TO AUTHORIZE AND DIRECT THE SECRETARY OF THE INTERIOR TO
ENGAGE IN A SPECIAL STUDY OF THE POTENTIAL FOR GROUNDWATER RE-
CHARGE IN THE HIGH PLAINS STATES, AND FOR OTHER PURPOSES

H.R. 71

AN ACT TO AUTHORIZE AND DIRECT THE SECRETARY OF THE INTERIOR TO
ENGAGE IN A SPECIAL STUDY OF THE POTENTIAL FOR GROUNDWATER RE-
CHARGE IN THE HIGH PLAINS STATES, AND FOR OTHER PURPOSES

WOODWARD, OKLA., FEBRUARY 17, 1984

Part 2



Printed for the use of the
Committee on Energy and Natural Resources

U.S. GOVERNMENT PRINTING OFFICE

34-228 O

WASHINGTON : 1984

5311-35

COMMITTEE ON ENERGY AND NATURAL RESOURCES

JAMES A. McCLURE, Idaho, *Chairman*

MARK O. HATFIELD, Oregon
LOWELL P. WEICKER, Jr., Connecticut
PETE V. DOMENICI, New Mexico
MALCOLM WALLOP, Wyoming
JOHN W. WARNER, Virginia
FRANK H. MURKOWSKI, Alaska
DON NICKLES, Oklahoma
CHIC HECHT, Nevada
JOHN H. CHAFFEE, Rhode Island
JOHN HEINZ, Pennsylvania
DANIEL J. EVANS, Washington

J. BENNETT JOHNSTON, Louisiana
DALE BUMPERS, Arkansas
WENDELL H. FORD, Kentucky
HOWARD M. METZENBAUM, Ohio
SPARK M. MATSUNAGA, Hawaii
JOHN MELCHER, Montana
PAUL E. TSONGAS, Massachusetts
BILL BRADLEY, New Jersey
CARL LEVIN, Michigan

MICHAEL D. HATHAWAY, *Staff Director*

CHARLES A. TRABANDT, *Chief Counsel*

D. MICHAEL HARVEY, *Chief Counsel for the Minority*

SUBCOMMITTEE ON WATER AND POWER

DON NICKLES, Oklahoma, *Chairman*

MARK O. HATFIELD, Oregon
MALCOLM WALLOP, Wyoming
FRANK H. MURKOWSKI, Alaska
CHIC HECHT, Nevada
DANIEL J. EVANS, Washington

PAUL E. TSONGAS, Massachusetts
WENDELL H. FORD, Kentucky
HOWARD M. METZENBAUM, Ohio
CARL LEVIN, Michigan

JAMES A. McCLURE and J. BENNETT JOHNSTON are Ex Officio Members of the Subcommittee

RUSSELL B. BROWN, *Professional Staff Member*

(II)

CONTENTS

STATEMENTS

	Page
Barby, Gene, president, Save Our Water.....	50
Braley, Hon. J. D., mayor, Guymon, Okla.....	55
Bryant, Jim, water resource planner, planning and development division, Oklahoma Water Resources Board.....	72
Buchheit, Barbara, Guymon Community Development Director.....	57
Compton, Ralph, Cimarron County Irrigation Users, Panhandle Gas Users Association.....	67
Frazee, Claude, Elmwood, Okla.....	70
Higgins, Virgil, Panhandle Well Head Gas Users Association.....	65
Hinds, Gene, regional director, Bureau of Reclamation's Southwest Region, Amarillo, Tex.....	3
Jameson, Rick, executive director, Oklahoma Wildlife Federation.....	71
Jeffus, Worth, Guymon, Okla.....	68
Kile, Clyde, Beaver County Irrigation.....	49
Knox, Dr. Robert, environmental engineer, Environmental Ground Water Institute, University of Oklahoma.....	46
Lockwood, David, executive director, Oklahoma Economic Development Association.....	48
Lucas, Tom M., Buffalo, Okla.....	18
Luthi, Jack, Woodward Chamber of Commerce.....	52
Meyer, Hank, city attorney, Woodward, Okla.....	19
Moore, Frank, Oklahoma Farm Bureau.....	61
Meyers, E. E. "Gene", city engineer, Woodward, Okla.....	21
Nickles, Hon. Don, a U.S. Senator from the State of Oklahoma.....	1
Osborn, Dr. James E., head of the Department of Agricultural Economics, Oklahoma State University.....	35
Saunders, Ben, Colorado Ground Water Districts.....	58
Weeks, Jack, Water Resources Division, U.S. Geological Survey, Depart- ment of the Interior.....	6
Woods, Hon. Ellis, mayor, Gage, Okla.....	15

APPENDIX

Additional material submitted for the record.....	75
---	----

GROUND WATER RECHARGE IN THE HIGH PLAINS STATES; AND DELIVERY OF WATER TO THE NORTH PLATTE IRRIGATION PROJECT

FRIDAY, FEBRUARY 17, 1984

U.S. SENATE,
SUBCOMMITTEE ON WATER AND POWER,
COMMITTEE ON ENERGY AND NATURAL RESOURCES,
Woodward, Okla.

The subcommittee met, pursuant to notice, in the Civic Center's Pioneer Room, Woodward, Okla., Hon. Don Nickles, presiding.

Present: Senator Nickles.

Also present: Russell R. Brown, professional staff member; and Craig Gannett, counsel for the minority.

OPENING STATEMENT OF HON. DON NICKLES, A U.S. SENATOR FROM THE STATE OF OKLAHOMA

Senator NICKLES. Good morning. I want to express my appreciation and thank you for coming this morning. Many of you came from quite some distance, and many of you have proven an interest in ground water recharge. Just from my conversations with you out there in the audience, I am impressed with the background and homework that you all have done on this issue. The committee that I am chairman of, the Subcommittee on Water and Power in the Senate, certainly has an interest in water, and an interest in water recharge. I think it is an opportunity that we need to take advantage of. And the sooner that we do take advantage of the exploring, the technology that is available, the opportunities that are available, then the better off that we will be in this country. Because water is certainly the lifeblood of this country.

I am deeply concerned about the depletion of our ground water resources. I think this concern is shared by almost every member of this committee, and probably every Member of the Senate if they've looked at the problem as we have. So I think that there is a lot of support. There is a lot of concern. It is important that we move as rapidly as possible to explore the various avenues of expanding our water recharge as much as possible.

In my opinion there is probably no better place to examine ground water recharge than in western Oklahoma. We have a number of Oklahomans that are scheduled to testify, and some from outside of the State that have expertise about the severity of water problems from personal experiences. The purpose of today's hearing is to seek the views of knowledgeable people who are involved with ground water

problems; and second to seek your advice on legislation which is now before Congress.

I am the sponsor of legislation in the Senate. Senate bill 1811, which will establish a program of ground water recharge and development in the Western States. It should be noted that almost identical legislation was passed in the House of Representatives last year. And I will work to get the bill passed this year in the Senate. I'm optimistic that we will be able to get it passed.

It would be misleading to state that the bill is a solution to any specific ground water problem. The legislation authorizes a comprehensive program of research and development to be used to determine solutions. With this legislation we will take the latest ground water recharge technology and techniques and build demonstration projects that will enable us to solve ground water problems in Oklahoma, other States served by the Ogallala aquifer, and in other Western States.

Water is the lifeblood of the Western States. With it communities can strive and grow. Without it they will die. I intend to guide this subcommittee to do all within its power to develop water resources where they are needed the most.

This is, in my opinion, a beautiful country. It has really been blessed by a lot of natural resources. Water is one that we need to conserve and protect and work to see if we can replenish it.

We have been blessed with energy. A lot of people, when they think of natural resources, think of energy first. I think we need to think of water and energy. They are the lifeblood—the Oklahoma lifeblood—really of any economy.

So I think we need to take every precaution and every amount of effort that we can possibly do now to look into the future and see what can be done and see if we can't help, not only ourselves, but the future generations that are really dependent on water and on energy.

So that's the reason why we are having the hearing today. We've got a lot of outstanding witnesses, many of whom have come from some distances to participate. My philosophy is, it is important to have hearings in the field where it actually touches on the people and touches on communities that are really involved. Not just to have hearings in Washington, D.C., where you have the political hired guns come in and give their prepared testimony.

So I like field hearings. We've had field hearings in Oklahoma before, and they've been helpful to me as far as trying to decide how and in what direction we should go; the degree of public involvement, support, or lack of support—whatever the case is—on these various issues. I think they are very important. So I appreciate you coming to this hearing this morning.

We will have our guests in panels. I think that would help us move a little more rapidly. Maybe we'll get some more information out. On our first panel we have Gene Hinds from Amarillo. We have Jack Weeks from U.S. Geological Survey from Beaver. And also, we have Rick Smith, chief of planning and development, Oklahoma Water Resources Board.

Mr. Smith is delayed, and we will see if we can't work him in a little later. Gene, do you want to start?

**STATEMENT OF GENE HINDS, REGIONAL DIRECTOR, BUREAU OF
RECLAMATION'S SOUTHWEST REGION, AMARILLO, TEX.**

Mr. HINDS. Mr. Chairman, I am Gene Hinds, Regional Director of the Bureau of Reclamation located in Amarillo, Tex. I've been asked to provide some background information concerning Reclamation's activities in the northwest Oklahoma area.

I want to make it clear that I am not here to present testimony on behalf of the Department of the Interior or the Bureau of Reclamation concerning their position with respect to the ground water bill. Commissioner Broadbent did that at the hearing in Washington. My statement will focus on Reclamation's activities in northwest Oklahoma.

The Bureau of Reclamation has long been actively involved in studies of water supply problems in northwest Oklahoma, particularly in that area which overlies the Ogallala aquifer formation.

In the 1930's, 1940's, and 1950's, Reclamation conducted various studies of potential irrigation projects in the North Canadian River Basin of New Mexico, Oklahoma, and Texas. Much of the lands classified as irrigable in those early studies are now irrigated with ground water pumped from the Ogallala aquifer and other ground water basins in northwest Oklahoma.

In the 1960's, Reclamation completed the Oklahoma Basins Study. The findings of that study were presented in a 1967 report entitled "Water, The Key To Oklahoma's Future." It outlined preliminary plans for a major system of storage reservoirs and canals, designed to meet the long-range water supply needs throughout the State.

During the 1960's and 1970's, one of Reclamation's major planning efforts was directed toward a statewide water plan.

In the 1970's, Reclamation extended the findings of the Oklahoma basins study, working closely with the Oklahoma Water Resources Board, Corps of Engineers, Soil Conservation Service, and the State universities to develop the statewide "Oklahoma Comprehensive Water Plan," completed in 1980. That plan has been adopted by the State legislature as a general guideline for future development of the State's water resources.

In 1973, Reclamation completed an appraisal study of a multi-purpose water supply reservoir on the Salt Fork of the Arkansas River near Alva. No further studies of the Alva project have been done, as it appeared the local irrigators would be unable to repay the project cost allocated to irrigation.

In 1981, Reclamation concluded the Geary project investigation. That study assessed the feasibility of constructing a water supply reservoir on the South Canadian River between the Oklahoma-Texas boundary and Oklahoma City. Seven potential reservoir sites were studied, of which three were considered suitable for development. Although a water supply in excess of 100,000 acre-feet per year could be developed at any one time of the three sites, the short-term needs for water in that area were much less than that. So the Geary project has been set aside for future development whenever the demands for water are great enough.

In 1982, Reclamation completed an appraisal report on the Llano Estacado Playa Lake study in the high plains area of New Mexico, Texas, Oklahoma, Colorado, and Kansas. Thousands of playa lakes are scattered throughout that area. Collectively, these shallow depressions impound and evaporate an estimated 2 to 3 million acre-feet of water per year. Because of this apparent potential, Reclamation studied these lakes to determine whether they could be developed to provide additional water supplies in the water-short high plains area. The study found that the potential was great for individual modification and use of the playa lakes by private landowners, but the economic feasibility of large-scale water projects to utilize the playa lakes does not look promising.

In 1979, the Oklahoma Economic Development Association office in Beaver contacted our Oklahoma representative in Oklahoma City, seeking assistance in meeting its future municipal water supply needs. The OEDA—Oklahoma Economic Development Association—is the association of governments organization for Oklahoma Planning District No. 11, an eight-county area in the northwest corner of the State. The Oklahoma representative met with the directors and staff of OEDA in 1979 to explain the Reclamation's program, and again in 1982, to present a proposed plan of study for the northwest Oklahoma area.

In July 1982, the OEDA directors passed Resolution No. 121, supporting the proposed study plans. Copies of the resolution were sent to the Oklahoma Water Resources Board and the Oklahoma Congressional Delegation. That investigation, called the "Northwest Oklahoma Water Supply Study," is scheduled to begin in fiscal year 1985; subject, of course, to the necessary congressional authorization and funding.

The study area for the northwest Oklahoma water supply study would include the eight OEDA counties of Cimmaron, Texas, Beaver, Harper, Woods, Woodward, Ellis, and Dewey. The proposed investigation has four major objectives:

One, to determine the short-term and long-term municipal water supply needs of the study area.

Two, inventory water resources of the area, both ground water and surface water, including water quality.

Three, to analyze the capability of existing or potential sources of water to meet the municipal and industrial water requirements of the area.

Four, formulate alternative plans to develop and convey water supplies from existing or potential sources to areas of need.

All potential sources of water will be considered, including ground water and surface water from existing or potential sources, and available water supplies of poor quality that might be made usable by special treatment or demineralization.

New irrigation development is not contemplated as part of this investigation. However, because irrigation is by far the greatest use of water in the study area, its use must be considered in assessing the municipal water supply needs and available water resources to meet those needs. The eight northwestern counties comprise one of the most water-deficient areas of the State. A declining ground water supply, which is virtually the only currently reliable source of water, poses a

critical problem. Recharge from the 18 inches of average annual precipitation cannot equal the present rate of withdrawal by pumping.

A regional comprehensive plan, including a water supply element, was prepared by OEDA in 1974 and updated periodically since then. Reclamation will work closely with OEDA and the Oklahoma Water Resources Board during the northwest Oklahoma water supply study. We will also talk to knowledgeable people in the area to get their perceptions of water supply problems and needs.

Considerable data on available water resources are already available from previous studies. The Ogallala aquifer has been extensively studied by the U.S. Geological Survey. Other ground water basins in northwest Oklahoma have been studied by the Oklahoma Water Resources Board and Oklahoma State University. The data from these studies will be analyzed to determine where, in what quantity, and at what quality ground water is available to meet future requirements.

Of the four major streams traversing or adjacent to the area, the North Canadian River is now fully appropriated. Some downstream reaches of the Cimmaron have water quality problems in relation to dissolved solids. The Salt Fork River is generally considered too saline for municipal uses. The Canadian River on the south has unappropriated water, but the quality does not meet recommended public health standards for municipal and domestic uses. Smaller streams are often saline and subject to wide variations in annual runoff. Both surface and ground water supplies are adversely affected by periodic droughts. Adding to the difficulty of surface water development are evaporation losses that greatly exceed precipitation. High winds, hot temperatures, and low relative humidity levels contribute to the high evaporation rate. Only limited amounts of additional good quality stream water are available for development.

Because the water supply problems of the area are formidable, the formulation of alternative plans to meet the future needs of the area will probably require some new and innovative solutions. Water conservation measures will be studied and recommended where appropriate. The substitution of saline or brackish waters for existing uses of fresh water will also be considered wherever possible. Special treatment or demineralization of poor quality water may provide the most feasible source of water supply in some parts of the area. Before any plans are proposed, however, they will be closely coordinated with the local people to insure that the most acceptable, effective, efficient, and complete plans possible for the area are ultimately recommended.

Several studies currently being accomplished by Reclamation under its technical assistance to States program, at the request of the Oklahoma Water Resources Board, may be useful in formulating innovative solutions to water supply problems in northwest Oklahoma.

In the first of those studies, we are assessing the technology and economic feasibility of alternative energy sources, that might be capable of supplying power for major pumping facilities. Included in this study is a review of the state-of-the-art of the various energy sources such as windpower, conventional solar, and other new technology. The study will also consider the relative costs and feasibility of developing and operating such facilities.

To assist in the assessment of wind energy potential, a probe unit has been installed at the airport near Gage. Probe stands for "Portable,

Remote Observations of the Environment." The unit has anemometers, to measure windspeed, mounted on a 25-foot tower. The unit reads the windspeed every 15 minutes, and transmits the data via satellite to computers in our office of atmospheric resources research in Denver. The transmitter is powered by solar panels. When sufficient wind data have been collected, they are analyzed by the computer, together with data from other probe units in the general area, to assess the potential for windpower generation.

The second technical assistance study is to assess the potential for demineralization of water from poor quality streams in western Oklahoma for public water supplies. It appears likely that some of the poor-quality water will be needed to meet municipal demands in western Oklahoma, prior to the time it becomes economically and politically feasible to transport water supplies from eastern Oklahoma. This study will include an inventory of water-quality data for selected streams, a review of recent technological advances in various desalting methods, and an assessment of the feasibility of treating various qualities of water to acceptable water supply standards.

The third study is to assess current irrigation water management practices and institutional arrangements that might have applications in Oklahoma. Reclamation has long been in the forefront of research and demonstration projects to promote more efficient use of irrigation water. The previous work by Reclamation and others will be analyzed, as a joint effort with other agencies and the State universities, to develop proposals for possible application in Oklahoma.

Mr. Chairman, that concludes my presentation.

Senator NICKLES. Thank you, Mr. Hinds.

**STATEMENT OF JACK WEEKS, WATER RESOURCES DIVISION, U.S.
GEOLOGICAL SURVEY, DEPARTMENT OF THE INTERIOR**

Mr. WEEKS. My name is Jack Weeks. I represent the Water Resources Division of the U.S. Geological Survey. As you know, Mr. Chairman, the mission of the Geological Survey is to appraise the quantity and quality of the Nation's ground water resources. This is accomplished primarily through three programs: A collection of basic records in surface and ground water, projects to appraise the water resources and ground water surface water resources of the country, and research on hydrologic mechanisms and methods of investigation.

With respect to northwestern Oklahoma, in cooperation with the Oklahoma Water Resources Board, the U.S. Geological Survey, monitors ground water stations and observation wells in over 400 observation wells that are measured annually in January. In addition there were four continuous record observation wells in the high plains of northwest Oklahoma. These wells provide the Oklahoma Water Resources Board and the U.S. Geological Survey with information on the changes of ground water resource resulting from ground water pumpage.

In addition to that program the U.S. Geological Survey is conducting a Federal funded investigation of the high plains regional aquifer covering 8 States extending from South Dakota to the Panhandle of Texas. The study is developing a regional computer model of the entire

174,000 square-mile aquifer system. The model will be available for studying the effects of regional ground water development patterns on the ground water resource.

Work on this project is headquartered in Denver and I am the project chief. And this project is expected to continue through 1986.

As a part of the high plains regional aquifer study, the Oklahoma City office of water resources division has conducted a detailed study of the ground water resource of the high plains aquifer in Oklahoma. This study has resulted in a computer model of the high plains aquifer in Oklahoma which was used to project the affects of pumpage on the aquifer for the next 40 years.

The results of this study have been approved and will be published by the U.S. Geological Survey in the near future.

Prior to the high plains regional aquifer investigation, the U.S. Geological Survey and Oklahoma Water Resources Board conducted a corroborative study of the high plains aquifer in Texas County, which produced a computer model of the aquifer system. That model was used as a preliminary tool for the development of the existing model that now covers Cimmaron, Texas, and Beaver Counties.

The model was used to project saturated thickness from 1973 to 1993 and also to year 2050 under several different assumptions about the future. The results of this study have been published in the U.S. Geological Survey open-file report 79-565.

The high plains regional aquifer investigation was conducted by the USGS and coordinated with a study of the social economic impacts of the claimed ground water supplies of the 6-high plains States. This study was contracted by the Department of Commerce, Economic Development Administration to a consortive of consultants.

The Oklahoma portion of that work was conducted by Oklahoma State University, Department of Agricultural Economics. These reports have also been published.

Some associated facts about the water resources of northwestern Oklahoma and, principally, the Panhandle Counties, which include an area of about 7,350 square miles, with a mean annual precipitation of about 18 inches per year. Free water surface and lake evaporation of about 62 inches per year or five or six times greater than the annual precipitation.

Surface water resources of the area include about one-half inch of run-off per year, which amounts to about 200,000 acre-feet. According to the Oklahoma Water Resources Board, the North Canadian and Beaver River systems are fully appropriated. There is no unappropriated surface water in the area.

Ground water storage in the Panhandle amounts to about 100 million acre-feet of water in the ground water reservoir in the Ogallala aquifer. The average annual recharge in that aquifer is less than a half-inch or less than 200,000 acre-feet per year.

Irrigable land in that area is approximately 2.7 million acres according to Oklahoma State University. Irrigated acreage is approximately 400,000 acres as of 1980 based on land set analysis of irrigated land. Ground water pumpage to irrigate that area is about 540,000 acre-feet in 1980 or over twice the amount of annual replenishment.

The effects of this pumpage on the ground water system has resulted in water level decline of up to 150 feet from predevelopment to

1980. The greatest of these declines are in Texas County near Guymon. Saturated thickness in that area has decreased from 25 to 50 percent of its original thickness in parts of Texas County, resulting in increased costs of irrigation and pumpage.

That concludes my remarks, Mr. Chairman. I would be glad to answer any questions that you may have of me.

Senator NICKLES. Thank you, Mr. Weeks. I have a couple of questions for both of you. For these Panhandle Counties, then, basically you said the recharge was something like 200,000 acre-feet per year, and the drawdown was 540,000 feet-acre per year?

Mr. WEEKS. Annual ground water pumpage for irrigation amounted to approximately 540,000 acre-feet for the year 1980. The average annual recharge or replenishment to the ground water system which will actually be occurring from precipitation on an annual basis is approximately 200,000 acre-feet.

Senator NICKLES. So irrigation, alone—

Mr. WEEKS. Is at least double the amount of replenishment.

Senator NICKLES. You just mentioned irrigation. Do you also have municipalities that are drawing water?

Mr. WEEKS. True; that's obvious. In addition to irrigation there is municipal and industrial use, domestic use, stock watering use, all of which are small users relative to irrigation.

Senator NICKLES. So if you added all of those uses together? I was trying to get the best ratio.

Mr. WEEKS. I don't know the exact numbers, sir, but my guess would be if irrigation pumpage is the order of 540,000 acre-feet per year, total pumpage is no more than 600,000, perhaps.

Senator NICKLES. So it could be as much as—

Mr. WEEKS. A small percentage of the total.

Senator NICKLES. The drawdown could be 3 times as much as the recharge?

Mr. WEEKS. Do you mean withdrawal.

Senator NICKLES. Yes.

Mr. WEEKS. The drawdown refers to the change of water levels from one point in time to another, but the withdrawal is 2 to 3 times that of natural replenishment.

Senator NICKLES. In regard to drawdown, I think you mentioned there is a drop in the water table of 150 feet from the original recorded levels.

Mr. WEEKS. In one area in Texas County.

Senator NICKLES. What about other areas say, in Cimarron County? Is there a similar drop?

Mr. WEEKS. Drawdown varies over the Panhandle. The least severe areas are in western Cimarron County. The most severe areas are in central Texas County in the vicinity of Guymon. And secondary severe areas occur in Beaver County.

The maximum drawdown—that is decline in the water table from predevelopment to 1980 is approximately 150 feet—in the vicinity of Guymon.

Senator NICKLES. What would be the average drop throughout this area? Do you have any idea?

Mr. WEEKS. I don't know the answer to that.

Senator NICKLES. Would it have been declining throughout the aquifer?

Mr. WEEKS. Probably 50 to 100 feet. I have maps of water level change for the entire high plains aquifer system, which I would be glad to leave those with you.

Senator NICKLES. I would like to see those. I was going to ask you—we have been talking about just Oklahoma, but this bill and the problem have national application. It certainly has application to all the high plains area—what has the aquifer been doing? Is this also under your jurisdiction as far as Nebraska and some of the other States that overlie the Ogallala Reservoir?

Mr. WEEKS. Yes.

Senator NICKLES. Are there similar declines in those States as well?

Mr. WEEKS. Yes. The most severe declines in the high plains aquifer system occur in the southern high plains of Texas, where in Floyd County, the water level declines in excess of 200 feet have occurred from predevelopment to 1980. Average rates of decline for a 4-year period of 5 feet per year. The most severe declines occur in the southern high plains of Texas; the Oklahoma Panhandle, and southwestern Kansas.

Senator NICKLES. They're not as much of a problem, say in Nebraska or—

Mr. WEEKS. There are problems in Nebraska, particularly in two areas; the Upper Republican Natural Resources District, which is near the Colorado and Kansas border and the Big and Little Blue National Resources District which is in southeastern Nebraska south of Plattford.

Senator NICKLES. What is the amount of precipitation that they have in the northern plains States?

Mr. WEEKS. Precipitation averages approximately 20 inches over the high plains. It increases from west to east from about 16 to a maximum of approximately 28 inches in southeastern Nebraska and central Kansas. Typically, the central portion in the high plains along—longitude at 102° —so the central portion in the high plains averages about 18 inches per year from north to south. Typically, the precipitation increases from west to east.

Senator NICKLES. Have you noticed a decline in the amount of irrigation due to the fact that natural gas prices are up?

Mr. WEEKS. The only area that we can identify that there has been a decrease in the rate of increase of irrigated acreage is in the southern high plains of Texas. In the southern high plains of Texas as the irrigated acreage has either remained constant or declined slightly over the last 5 years. Elsewhere it has continued to go up.

The Economic Development Administration's projections for the future show significant declines in irrigated acreage in the southern high plains States; that being Oklahoma and south Oklahoma and New Mexico and Texas, and significant increases in irrigated acreage in Nebraska, only. In fact, their projections are approximately equivalent increase in Nebraska to a decrease in these other high plains States.

Senator NICKLES. You mentioned that some counties have more severe drawdowns or depletions than other counties. How much of an overlap? If there's a great deal of irrigation or pumping in particular areas, do you see a drawdown in areas that are adjacent?

Mr. WEEKS. You're asking whether the effects of pumpage in one area extend out into adjacent areas. Yes; they do. But, in general, the nature of the aquifer is that the effects do not extend beyond relatively short distances, a few miles.

The aquifer is a water table aquifer with high storage properties which means in effect that the water is withdrawn with very little extension of the effects beyond the local area. Primarily, the major areas of decline occur where there are major developments, where irrigation has taken place, and in those areas where development began first. Development started in the southern high plains of Texas. The most severe areas of decline occur in the southern high plains of Texas. The development grew northward into Oklahoma and Kansas. The most severe areas are now occurring in Oklahoma and Kansas.

Declines of 10 to 25 feet occur in parts of Colorado, northwestern Kansas, and Nebraska. These areas developed later. Most of these areas didn't start development until the sixties. Then the irrigation systems became adaptable to rolling terrains and sandy soil, which were not suitable for application.

So these areas that began development later in the history of the irrigation of the high plains are now only beginning to see significant declines. One can logically assume that as time progresses and development continues that the northern part of the high plains will experience similar water level decline problems in the southern part of the high plains.

Senator NICKLES. Let me ask you, and I will ask our other panelists also, to gaze into a crystal ball or into the future. We've got a lot of farmers, and we've got a lot of other people, both communities that are dependent on the aquifer for their livelihood. They've seen a lot of change, and in many cases these were farms and ranches that were homesteaded and are now occupied by the third or fourth generations in some cases.

They've been assuming that water would be there, and now they are a lot more skeptical because they've started to see possible shortages. What's it going to be like 10 years or 20 years from now? Is the water going to be there? Are they going to be able to irrigate? In some cases, as I'm sure you are aware, they can't farm if they can't irrigate. Can you give us your guesstimate?

Mr. WEEKS. I'm not prepared to make that projection. The regional aquifer study that I am in charge of is attempting to scientifically evaluate the answer to that question through the use of computer models of the aquifer system, which we will then use to simulate pumpage into the future and project what effect that pumpage will have on the aquifer system. Hopefully the use of that tool will enable water managers to evaluate precisely that type of question, given a set of assumptions about future pumpage.

Senator NICKLES. Let me try and extract it, then. If we are pumping out 2 or 3 times more than is being recharged at that present rate, how many more years would we have until we are going to have really serious shortages?

Mr. WEEKS. You already have serious shortages in some areas. In the southern high plains of Texas you have serious shortages; in Floyd County, Lubbock County, and several of the counties of the southern high plains of Texas. You are already experiencing severe water level

declines in Texas County, Okla. In several southwestern counties of Kansas the problem is already at hand.

Senator NICKLES. The problem's already here? And you expect it will only grow and increase and move north?

Mr. WEEKS. Yes, sir; and the only question remaining is how fast it will grow and how severe will it be at any given time in the future. Those questions we hope to be able to improve or to be able to address as a result of this regional aquifer study being conducted by the Geological Survey.

Senator NICKLES. You mentioned that this survey was trying to look ahead 40 years and that it was already approved and soon to be published.

Mr. WEEKS. The regional aquifer's system investigation that the Geological Survey is conducting is being conducted in two parts. A regional investigation that looks at the entire 8-State area, 174,000 square miles, and a more detailed investigation of local areas within individual States. Within the State of Oklahoma the Oklahoma Office of the Geological Survey conducted a model study of the three Panhandle Counties. That report has been approved by the directors of the Geological Survey and is ready for publication. That report makes projections of the water level changes—I'm not sure how far in the future.

There was a prior report on Texas County, only, that made projections to 1993 from 1973 and also to 2050.

Senator NICKLES. And that was your report No. 79-565?

Mr. WEEKS. Yes, sir.

Senator NICKLES. And that is presently available?

Mr. WEEKS. That's a published report available from the Geological Survey published in 1979.

Senator NICKLES. How would an individual or community or an irrigating district get a copy of that report?

Mr. WEEKS. They would ask their Congressman or Senator or contact the Geological Survey Office in Oklahoma City or any USGS Office and request a copy.

Calling USGS is the most direct way to get the report form.

Senator NICKLES. And you expect that this other report will be coming out pretty quick?

Mr. WEEKS. Yes. That's the current report, the current projections based on data through 1980 as opposed to 1973 and covers Cimarron, Texas, and Beaver Counties.

Senator NICKLES. I look forward to getting that report. I would appreciate your making sure that this committee gets a copy of it as soon as it's finished. That may have some of the answers that we are looking for.

Mr. Hinds, there's a couple of questions in general. We've heard a pretty sobering scenario on what's happening with the high plains aquifer and the way it's being depleted. The water is being mined on a ratio of 3 times as fast as it's going in. You and I are also familiar with other aquifers that are doing just the opposite. The recharge capabilities are just the opposite ratios. Three times as much water is recharging as being used. So those aquifers are in pretty good shape. And we have aquifers all across the country. Some of them are in good

shape, and the high plains is being depleted in this area as Mr. Weeks just explained to us.

You are from the Amarillo area, and I was visiting with you earlier. You and I are familiar with some of the attempts that have been made to do what this bill is trying to do. We need to explore and perfect techniques that individuals, universities, and others have previously explored in order to enhance the recharge capability and see if we can't decrease this ratio of pumping 3 times as much as is recharged, possibly to increase the recharge capability. Could you describe to us, what the Bureau has looked at and some of the ideas that we might be able to explore under this bill for demonstration projects to enhance recharge capability.

Mr. HINDS. The Bureau hasn't done any actual recharge work in the high plains area, but we have looked at some that has been going on. It appears that economics of pumping may put the farmer out of business before the ground water aquifer is completely dry because they have fallen that far. So down in the high plains area around Lubbock there is an individual irrigation district that's done a great deal of research on squeezing that last drop of capillary water out of the upper zones of the Ogallala by injecting air pressure into that zone and forcing the capillary water down into the area that's being pumped.

It looks promising right now. The cost of doing that is about \$50 an acre-foot. They are having a little trouble getting research money because some people are skeptical that it's going to continue to work. But they have some pretty good data accumulated to demonstrate that this is working.

This is not ground water recharge, however, but it is squeezing a little more water out of the upper area into the area that they can economically pump.

We have looked, as I mentioned in my statement, at the playas. There's a great deal of water. I was surprised at the quantity of water that fills those flat little reservoirs when they do get rain. The problem with a large development, such as the Bureau of Reclamation would look at, is economic. You'd have to somehow accumulate that water into a big reservoir some place; gather, accumulate it, and then, utilize it in the area. It's more economic for the individuals to do it themselves. Another thing that you would run into is the right to that water. That's not Government land that this falls on; it's all private land. So you run into some institutional problems there.

Senator NICKLES. This land is in New Mexico?

Mr. HINDS. Well, the lands are in New Mexico and Texas and Oklahoma. We've looked at the play as all over this part of the country.

Senator NICKLES. Those would be the individual small ponds or lakes.

Mr. HINDS. Well, they are at the present time. They are just small depressions, natural depressions where the water accumulates. If you fly over the area after a rain storm, you will see them all over the place. A great deal of water accumulates there. When we studied it, we looked at the potential of accumulating the water from a large number of these playa lakes, into a project, and we found that it wasn't economical to do that; but the individuals themselves, can develop. And one guy is experimenting with getting that water into the ground before it evaporates and then pumping it back up.

Senator NICKLES. Are they losing right now most of that water by evaporation?

Mr. HINDS. Yes.

Senator NICKLES. Are there some techniques, perhaps by injection or some other method, where you could store the water underground before you lose it to evaporation?

Mr. HINDS. There are techniques for that. It hasn't proven too successful because of the treatment that's required before you put it back in the ground.

Senator NICKLES. Do you harm the quality by doing that?

Mr. HINDS. Well, you know, when it runs off, you gather sediments, and you find that you're plugging your screens when you inject it. Oftentimes there will be bacterial accumulation that causes plugging. And it's just a problem. The water has to be clean when you inject it, or your injection process doesn't work as well as it should.

Senator NICKLES. You mentioned that we have water quality problems with streams and rivers in the area because of too much salt or other chemicals and that they wouldn't provide us with the opportunity for recharge capabilities. You also mentioned that other streams were already committed, so we don't have an opportunity there.

Is there water in this area that we can capture by injection or other methods, techniques, spreading ponds, or something, so we can grab hold of it and take advantage of?

Mr. HINDS. Well, as I mentioned in my testimony, there are some potential sites for about 100,000 acre-feet. That would be confined to a certain locality. That locality may or may not need ground water recharge. I'm not sure of my geography up in this area, yet. But at any rate, there is some potential for a small amount of water. I think, Senator, that probably if we're looking at large scale ground water recharge we are probably looking at importation of water in the high plains area. My companion here from a sister agency could probably talk to you more about that.

But at any rate, we feel like the recharge in this area is going to require some outside water, either through weather modification or import.

We have not been able to find suitable sites in the immediate vicinity. We haven't gotten into that study yet in detail, but at any rate, we feel that recharge is going to require some water from weather modification or import.

Now, if you import water into the area, you and I know that it is expensive to put it in the ground and pump it back out again. An importation plan is going to be expensive at any rate.

The water that is presently available in these streams—and there is water available, but it's highly mineralized—would probably have to be treated before you put it in the ground. EPA has rules and regulations on the kinds of water that you put in the ground.

Senator NICKLES. Are their regulations too stringent for irrigation uses or industrial uses or whatever?

Mr. HINDS. I can't answer that. I'm not familiar with how stringent those regulations are. But I know they are pretty strict on the types of water that you put into an aquifer. For instance, if it is a sweet aquifer at the present time, you wouldn't want to be putting saline waters into the aquifer.

Senator NICKLES. How is the water quality in the Ogallala Reservoir?

Mr. HINDS. In general, water quality is good. It is certainly suitable for irrigation and virtually all crops that are grown in the high plains; and in most areas—not all, but in most areas suitable for domestic uses.

Senator NICKLES. So no real problem there?

Mr. HINDS. Not in most areas. In some areas there are problems. Areas underlain by bedrock, marine origin, cretaceous rocks in the southern high plains of Texas—there is some very poor quality water where the Ogallala is in contact with late cretaceous rocks of a marine origin. Also, in Beaver County, Okla., and Southwest—northern Texas and Beaver County, Okla., and parts of Kansas, where the area is underlain by Permian bedrock, there are very high concentrations of dissolved salts in some wells where water is being sampled from the Ogallala at the base of the aquifer in contact with these Permian rocks that contain salt. There are concentrations of many thousands of milligrams per liter dissolved salts in some of these areas.

Senator NICKLES. Does the water quality change as far as the difference in the depth of the aquifer?

Mr. HINDS. In the areas underlain by Permian, yes, sir.

Senator NICKLES. So you might have good water on top—

Mr. HINDS. Good water on top and poor water on the bottom and as water levels decline in the aquifer there is potential for increase flow upward from the underlying rocks which further complicate water problems in the Ogallala.

Senator NICKLES. I'm really concerned, Mr. Weeks, when we state that we already have the problem. I think if we've got a problem, we need to admit and state it, and the people that are farming need to know it. And particularly, when you say: "Yes; the problem is already here."

When you say the problem is already here, does that mean that people in some of the counties in Texas and Oklahoma have wells that are not producing as much, and they're not getting as much out of the wells, and it costs that much more to pump them?

Mr. WEEKS. In part of the southern high plains of Texas, the 7-county area, the number of acres irrigated per well has declined from an average of 120 to about 65 over a period of about 20 years. The number of wells in those counties have increased from something like 20,000 to 30,000 to make up the difference. Now, they have more wells pumping less water. And that has to cost more.

Senator NICKLES. But the total amount of irrigation?

Mr. WEEKS. Has actually increased.

Senator NICKLES. Has actually increased?

Mr. WEEKS. Yes.

Senator NICKLES. So they're still getting water out but they're working harder to get it out?

Mr. WEEKS. Economics are still in their favor; and I shouldn't say for everybody, but in general they're still in their favor. I'm sure that there have been individuals who have lost their wells on the edge of the aquifer that has since gone dry or no longer can yield the quantities that are necessary to irrigate whatever area they were intending to initially irrigate. I don't have any details on that or specifics to give you.

Senator NICKLES. At some point would this be like an oil or gas well where the economics were just not there to get that last amount of water?

Mr. WEEKS. Absolutely. You can't get it all. We can say there is 100 million acre-feet of water in storage in the Panhandle of Oklahoma, but we cannot recover all of that because as water levels decline it will become uneconomic to pump the water for use; which in this case was primarily irrigation. When that happens, they will stop pumping. There will still be water there.

The cause for that—the cause for the decrease in the amount of pumpage or the increase in the pumpage in its entirety will be the cost of energy and the increased cost of greater lifts to get the water out of the ground. The lower the water is the more units of energy must be used in order to recover it.

Senator NICKLES. Mr. Hinds, just one last thing. You mentioned the study that I've been pushing which now the Bureau has in their budget. And we will get it appropriated this year, I'm confident of that. The study touches several counties in northwestern Oklahoma including Woodward and Woods and Cimarron and Panhandle Counties. You mentioned the objectives of that study. I think funds would begin in 1985 at \$85,000. I'm trying to remember what the total of it is. Do you remember?

Mr. HINDS. I don't. Do you remember, Andy?

Mr. PECK. No; I don't.

Senator NICKLES. It might cost a total of \$600,000 or \$700,000, but I think it's about a 5-year study. We hope that will be coming up and hopefully there would be some positive results that will help some of these municipalities and also the irrigation districts and others to see where we are and to see what changes can be made. We expect that that will be coming before Congress, and I look forward to working with the Bureau and the USGS to determine where we are. The information that you both provided today has been helpful to me and I think to this committee. We will continue working with you to assess our situation. Certainly, we do have a very, very serious problem in northwestern Oklahoma concerning water. I believe it's going to take a combination of a lot of efforts and information and direction. We'll look forward to working with you and cooperating with you in trying to come up with some of the solutions to these very difficult problems. Thank you very much.

Our next panel is the Honorable Ellis Woods, mayor of Gage, Hank Meyers, city attorney for Woodward, Mr. Gene Myers, who is the city engineer for Woodward, and Mr. Tom Lucas from the city of Buffalo.

STATEMENT OF HON. ELLIS WOODS, MAYOR, GAGE, OKLA.

Mr. Woods. Good morning, Senator. I'm Ellis Woods, the mayor of Gage and also owner of Community Jersey Farms that does quite a little bit of irrigation in Ellis County. I want to preface what few remarks that I may have here this morning with a couple of apologies. One of them in my haste to get here this morning I forgot my hearing aids, and I'm a little bit hard of hearing. So if I misunderstand some questions, excuse me, please.

Senator NICKLES. A lot of Senators are hard of hearing, too, so don't worry about that.

Mr. Woods. And second, certainly, this presentation will not be of the expertise of the two gentlemen who proceeded me here in this hearing.

I would like to commend you, Senator, for your interest in getting some ground rules reviews of importance of maintaining the quality of water and the needs of this for the segments of all of our economy here in this particular area.

In our own irrigation set-up we have one well in the Wolf Creek aquifer. We have three in the Ogallala aquifer. And for some particular reason it's so different than the information that I've been hearing. I know that this is the information that is true in regards of the dropping of the levels in the aquifer. In the last three major ones of our wells in Ellis County these levels have increased. I guess we are on the downhill side of the Ogallala aquifer. But 2 years ago our water level in the wells that are in the Ogallala aquifer were about 41 feet. A year ago that level as measured by our State water resources board was 39 feet. This year that level has been 38½ feet for some reason or another. In our particular area the level has come up a little.

Knowing the number of people in Texas County, I know how theirs has gone down. I don't understand this. I just know that we appreciate the fact that we have a little more water available than we thought we did a year or two ago.

We are not in a position to pump near the amount of water that we were when we started irrigating, just due to the general economy of the thing. The sickening dilemma in agriculture is we raise wheat, and we sell milk. All of the [inaudible] just do not justify our water near to the amount that it should.

We started irrigating in 1968. Our cost was about \$250 a month per well in pumping. We used sidebowl systems, which don't utilize a great amount of water, something like 400 gallons per minute, and we run about four systems.

This last year our costs were running close to \$2,000 a month per well. You just can't justify no bigger acreage than we have the type of operation.

Senator NICKLES. For wheat?

Mr. Woods. Per month.

Senator NICKLES. I know, Mr. Woods. But what are you growing; wheat?

Mr. Woods. Yes—well, we quit irrigating wheat altogether. We irrigate feed grains and alfalfa.

I just might mention another fact; that since we started irrigating in our area, the amount of feed that is available to buy by the dairymen and by livestock feeders has made a tremendous difference in the economy of the country. Now, the dairies, alone, purchase about a \$1½ million worth of grain and hay a year. And we're outnumbered by people who feed beef by about 41, I imagine.

Rather than go out of the country to buy this feed, it is raised locally. Our dairymen save the price of the freight as well as keeping that money in the local area. This has been the State advantage and one we certainly hope that we can keep a water supply available to keep that particular advantage.

Now, those wells that are in the Wolf Creek aquifer, the water level there is determined by the level of the run of the river. When that

river is running at a constant average stream, that water level stays up in those wells at a real adequate position. At extremely dry times in the summer we see it go down a little bit. With the advent of dams and terracing and this nature has come about in the last 2 years, river level is much more constant than it used to be. I think that this has been a State's advantage, there.

One other question that I thought I heard you ask a little bit ago in regards to the quality of the water in and maybe below this aquifer. There at Gage in 1916, I think there is a number of people here in the room that would recall this better than I do, but in the process of drilling a well with this type of machinery—I mean an oil well—with the type of machinery that they had at that time at about a 600 foot depth they hit an artesian well. This thing blowed their equipment right back out of that hole. And since 1916 that thing has run constantly and it's still producing 230 or 240 gallons a minute. It just flows as free as the breeze. But the quality of the water is not usable for anythink except for picnicing lake, and swimming pool.

So underneath this Ogallala aquifer I guess there is an bundance of water, but it's not the type of water that we can use.

I just had an experience a short time back—oh, it's been 3 years ago—of coming from Dallas-Fort Worth Airport to Amarillo sitting seat mate with an individual who was one of the operators at the Bushland experiment station out of Amarillo. I asked him a question, "Why is our Ogallala formation going down like it is?"

And he said, "Well, the Pecos River that drains the snow melt off of the east slope of the Rockies has evidently cut below the area where it recharges this particular deal."

And I thought, "Gee, that ought to be simple to cure. All we need is a series of dams on the Pecos River."

But that idea is like, I guess, a lot of others I have in the dairy that I don't make much money with in my work.

I know that our little town of Gage, there, is able to do with the abundance of water that we have. We use, say, two wells in the Wolf Creek aquifer and one in the Ogallala formation. But we are able to pump water—and an extra fine quality of water—for the use of our citizens that they can use water pretty freely and afford it.

We would certainly hope that in this series of hearings that you can come up with something that you can keep us in the position to be able to do that. I believe that's about all that I have.

Senator NICKLES. So you are in better shape than, maybe, some of the other counties?

Mr. Woods. We are in excellent shape right there right now. I don't understand—I mean I would like to talk to some of these gentlemen who are much more knowledgeable than I am on why our water level has come up there in that particular area.

Senator NICKLES. Do you have a lot of irrigation in Ellis County?

Mr. Woods. Well, there's much more than there was when it started in 1950, but I don't know exactly how many wells that are really in operation now. We appraised an estate—I was on a team of a appraisers for appraising an estate about a week ago that had irrigation wells on it. One of the appraisers said, "This land where the irrigation wells is probably about \$100 an acre cheaper than what the others is due

to the cost of running irrigation. It wouldn't be as valuable as it was if it were—

Maybe this is the idea that a lot of people have. I know that we are not irrigating as much as we did a short time back.

Senator NICKLES. Thank you very much, Mr. Woods. Mr. Lucas?

STATEMENT OF TOM M. LUCAS, BUFFALO, OKLA.

Mr. LUCAS. My name is Tom Lucas. I speak today in behalf of the citizens of the town Buffalo, Oklahoma, and in behalf of Mr. Glenn Sullivan, chairman of the Oklahoma State Chamber of Commerce Water Development Council, of which I serve on the executive committee. We appreciate your interest in western Oklahoma's ground water, and we thank you for inviting us to participate in this hearing.

Towns like Buffalo, Beaver, Woodward—in fact, all of northwestern Oklahoma depend on ground water for their water supply. Ground water is the lifeblood of this area. Our key to survival and to economic progress depends on our ground water and having it in sufficient quantity and quality to supply our present and future needs. As we all know, the reserves of the major ground water basin in this area, the Ogallala, has been steadily declining for the past several years. Annual usage is exceeding the amount of natural recharge that occurs in the reservoir and as a result, water tables are seriously dropping. Other ground water basins in the area, less significant than the Ogallala, but still as important to the people that overlie them, are also declining at a steady rate. I will not go into all of the problems and the concerns that are associated with the declining water tables since that has been much discussed anyway. I will instead try to discuss some of the alternatives.

Over 10 years has elapsed since we began to realize the seriousness of our declining water supply occurring within the Ogallala. During that time, we have done little more than study and talk about the problems. Congress, through the efforts of Senators Bartlett and Bellmon, have made several million dollars available for a project called the high plains study. That expenditure resulted in a study that amounted to a rehash of what was already known and contributed very little toward solving the problem. The alternatives are these: That we do nothing and continue to use the water as we are now until it declines to a level that is no longer practical to use, or that we begin conservation efforts to increase the remaining life of the reservoir, or that we begin an extensive weather modification project to increase rainfall, or that we push for the development of a water transfer plan, or that we push for the development and completion of reservoirs which will supply us with surface water, or that we push for development a system to recharge the aquifer by adding more gallons back into the reservoir than are being used.

If we do nothing but continue to use the ground water, we commit northwestern Oklahoma and its future generations to ultimately have to leave the area. Conservation is necessary, but it only prolongs the ultimate result and does not solve the problem. Weather modification has never gained public acceptance. A water transfer plan that has been proposed by the Oklahoma Water Resources Board to move Oklahoma water from east to west has become so political and controversial that it is years away from becoming reality. Large reservoirs require large expenditures on the part of the governments and there is little

likelihood of those appropriations being made. Much of western Oklahoma's stream water is committed to Oklahoma City and Tulsa and has been for many years, and tremendous political problems are created when proposing reservoirs that interfere with the volumes of water that are now committed to eastern Oklahoma.

It appears, then that one of the more feasible alternatives may be to find a way to recharge the aquifer by the use of additional water. Because of the time required, which is years, for water now on the surface to reach the aquifer, surface storage of water in increased amounts is not likely to solve the problem within the time available. Perhaps the best alternative may be to consider the application of an oilfield technique used in secondary recovery operations. Perhaps the Ogallala could be recharged by direct injection of water into the proper zones.

The first question is where do we get the water for injections? The most likely source would be to build a series of small reservoirs where they could be permitted and utilize a portion of that water for recharge by injection. Other sources would involve a water transfer from some other area or a release by eastern Oklahoma of some of the water dedicated to it, but that would still involve the construction of dams to hold the water in this area. The greatest recreational and economic benefit that would accrue to this area would be from the construction of several smaller reservoirs and the usage of some of that water for recharge.

It has been 15 years since I first became active in water development activities. Nothing has been done of any real value toward this problem in that period of time. It is a concern of our Government officials but not a priority. It should be a priority. Oklahoma has \$300 million of immediate needs to correct the deficiencies and needs of 1,100 community water supply systems, and only expects to have \$75 million to spend toward it in the next 3 years. Recharge of the Ogallala is not included.

Our hopes now lie with you, Senator Nickles, in your recognition of the problem and in your ability to convince the Congress to help us. We hope that this is the beginning of a renewed effort to find a real solution to the problem. I will be glad to respond to questions.

Senator NICKLES. Thank you, Mr. Lucas. Mr. Meyer?

**STATEMENT OF HANK MEYER, CITY ATTORNEY,
WOODWARD, OKLA.**

Mr. MEYER. Senator, I believe you got our statement that we prepared. I'm Hank Meyer with the city of Woodward, city attorney. I will leave some of the statements to Gene Myers, who is the city engineer. With respect to the city of Woodward, it is approximately 14,500 people. We have a water supply that takes care of 21,000 to 27,000 people. When you take into effect the motels, restaurants, and so forth, of the city, over a period of since 1911 we have garnered the major source of our water, ground water, that we supply to the city from what is known as the north water field, which is north of the North Canadian River.

In approximately 1943 the U.S. Air Force drilled some wells into the Ogallala reservoir or aquifer. In 1964 we began development on that. Today we get approximately 75 percent of all the water for

domestic use in the city from the Ogallala aquifer. With the remaining 25 percent from the north water field.

The facts that we have gone into when considering the House report, the present levels of the aquifer have declined, maybe not measurably significant, to where we could qualify for a demonstration project, and we have asked that Guymon—though from facts that are known to us—the Guymon area, Texas County, specifically, be made a part of a demonstration project if this bill is adopted by the Senate and signed to the law by the President.

We are totally in favor of this bill, both phases; phase 1 and phase 2, conclusion of the total, which is somewhat different than Mr. Carruther's letter, I believe of November 7, 1983. We think that the project should be funded initially. We would ask that pollution be addressed in the study because we think that it is of critical significance. Maybe the major threat to the aquifers that presently exist would be that if the aquifer was polluted to where this city had to shut down. Even if we went to the north water field, we could not serve the citizens in the city. The farmers and ranchers have been hit dramatically, not only by the farm prices, but I believe as well by the cost in utilities that this city has experienced from 1983 with electrics, specifically. Since 1983 in January to 1984, we have experienced with one utility company an 87-percent increase. We spent in 1983 to 1984 \$153,000 on one company and \$105,000 on another company. It would follow just as easily if the aquifer would deplete it's going to cost us more to pump from this area.

With respect to the in-kind contributions that I believe are under section 3 of the bill or section 4—3, the city would ask that not only what is used at this time be counted as in-kind contributions, but in 1964 we drilled about 133 wells, and we've got data, logs, for 113 logs that the past be used as an in-kind contribution. The basis for that is is that the commission of the city of Woodward is funding a hospital of approximately—with bonds—of approximately 90 beds at the present time. We comply with the EPA standards on sewage, which is about 1.3 million, and we decreased our major source of income on sales tax. And we have been devastated lately with respect to coming back to a level that was approximated at about 1981 in having—because of the oil problem that we all have.

In addition to that, the city has tried to utilize some of the conservation measures and specifically, has taken affluent from the sewage and has, when gone through a process, irrigated one of the city golf courses now. Which what happens, we've got plans in addition to irrigate another city golf course within the city limits and city parks, which would necessitate or which would allow the city to shut down on production from the Ogallala aquifer for about 4 wells. In other words, to go ahead and use those 4 wells for solely domestic use.

I think that the city has tried to maintain a conservation on that, and I think that that's been beneficial, of course, to the aquifer.

In addition to that, our reasoning behind Texas County would be that there's a transmissibility of water that if Guymon, Okla. has a problem within X amount a number of years, it's going to reach us; that that water flows from Guymon to Woodward, and that is why we think Guymon should be a project and I'd urge—which I'm sure we could count on your support if possible for the Guymon area in Texas

County for one of these projects such as Wilson or Boren's or Congressman English.

I believe that we have covered most of it. Under section 2 of the bill, we would urge this, that the language not be stricken which allows, which requires the word "shall" is used. To require the Bureau to garn information from the local entities. The reasoning for this is that I know that we can always have success in dealing with you, that we might have—it allows us input into the Bureau, itself. We've had very good relationships with the U.S. Geological Bureau of Reclamation and so forth.

I don't think I have anything else. I can state that we have been fortunate to have had the city managers in the past and city commissions that have known that water is of the highest critical need for the city. To summarize that if polluted our 75 percent water source, it would basically kill us as far as any expansion. Our retail businesses garner and grow because of having a population here, and we hope we can consider ourselves a progressive city. The field is located south to southwest county here in Woodward. We know that the feet has been reached for the irrigation at the present time and that's not due just to the utilities, but to the land contours in Woodward County, itself in that area. We would urge adoption of this bill and commend you for the introduction of the bill and would state as well that we understand that it is a research and development and that it is needed. It is of critical importance to us so that we can make intelligent decisions in the future.

Senator NICKLES. Thank you, Mr. Meyer. Mr. Gene Myers.

STATEMENT OF E. E. "GENE" MYERS, CITY ENGINEER, WOODWARD, OKLA.

Mr. MYERS. Senator Nickles and staff, I'm Gene Myers, civil engineer for the city of Woodward and with Myers Engineering Co. We have been employed on continuous basis with Woodward for over 26 years, and we have done considerable work for them in and around the area. Most of our knowledge has been—what little we do know about the Ogallala—has been gained through the design and construction and operational procedures and facilities that are constructed in the Ogallala southwest of Woodward. We have been studying the effects of recharge and what it can do for our supply and the supplies and wherefores of it through actual wells, test holes, and the operational data. We, too, want to commend you and anybody else as far as that is concerned who is interested in water because we, as city engineers, know and realize that a city is at a standstill. They can't do anything without a suitable water supply.

Here in Woodward, as many others in the western part of the State here, and here in the Western United States, we are ground water oriented as far as the supply is concerned. So is agriculture. Most of agriculture is ground water oriented. So therefore, it is of vital importance that this be looked into you know. Either you or any predecessor or anything that you could do to help this. And I know that we in the industry out here and grass roots area, you know, we really need to be looked over. And we really commend you for that.

I just have a few short comments here. As the city engineer we would certainly support any program that you could introduce or cause

to come about to cause a more lasting source of supply for cities. We represent several of these for the northwest part of the area.

As Hank mentioned, our ground water—we're fortunate that in this area we are looking out here where we take ours, the ground water has not declined, and there is variations, however, due to seasonal and operational limits and times and that. But for many many years, now, since just after statehood, the city of Woodward has had a policy. They have adopted a policy. They have followed a policy of conservation through operational, the acquiring of water rights in conjunction with State laws and local laws and technical data that they have had. Because they know that anything that they do today, 100 to 200 years later it's going to cause an effect. It's going to have an impact on the people then. So that's why we have to be very careful in anything that we do and anything that is done.

Also, the pollution effect that has been brought up in the aquifer. I think the gentlemen that were on the panel before up here mentioned that the introduction of nonpollutable water into a supply could probably deteriorate to the point that it would not be usable for you and I. So this has to be looked into. In some areas it, of course, has been done to regard the intrusion of saltwater and to push that back and cause the hydrolic head to go the other way.

It's also been mentioned a little bit here that water runs downhill underground the same as it runs downhill above the ground. We are on the lower end of this, and we're looking for not quite so much of the impact on the heavy pumping areas in the Panhandle and the Panhandle of Oklahoma and Texas. However, we do want to guard this. In our recharge for our resource of the water out here we guard this. We look between the two and try to balance it to the effect that it's not going to retard our use of the water in that particular area.

So I do think between the domestic uses, industrial use, and agricultural use, there is a balance. I, myself, as an engineer, I know that there is hundreds of thousands of us that would have the same concept and urge you that through bills, actions or some way that there is enough water, if we handle it right. And so anything that could be done on this respect, well, I think would cause us to enjoy it, you know, for years and years and years in the future.

[The prepared statement of Mr. Meyer and Mr. Myers follows:]

TESTIMONY ON HIGH PLAINS
STATES GROUNDWATER DEMONSTRATION
PROGRAM ACT OF 1983

BEFORE UNITED STATES SENATE COMMITTEE
ON ENERGY AND NATURAL RESOURCES,
SUBCOMMITTEE ON WATER AND POWER.

FEBRUARY 17, 1984

CITY OF WOODWARD, OKLAHOMA
PIONEER ROOM, CIVIC CENTER

BY: E. E. "GENE" MYERS
MYERS ENGINEERING
11330 N. MAY AVE.
OKLAHOMA CITY, OKLAHOMA 73120
(405) 755-5325
CITY ENGINEER, CITY OF WOODWARD

PREPARED BY:

HENRY A. MEYER, III
HIERONYMUS, HODGDEN & MEYER
P. O. BOX 529
WOODWARD, OKLAHOMA 73802
(405) 256-5517
CITY ATTORNEY, CITY OF WOODWARD

The City of Woodward, Woodward County, State of Oklahoma, has a water system which is presently able to serve an equivalent population equal to 21,000 to 27,000 and as of the 1980 Census, the City of Woodward was found to have a present population of approximately 14,500 people and serves a trade area of approximately 50 to 75 miles in all directions. The County of Woodward has a heavy abundance of agriculture and is a primary source of income in both farm and ranch, and the City is dependant upon this agriculture industry for much of its retail business. In addition thereto, the oil and gas industry made a significant in road into the City during the late 70's and early 80's, becoming one of its prime employers. The uses of water fall into categories of commercial, industrial and domestic consumption for the City of Woodward. Woodward serves an equivalent population of approximately 21,000 to 22,000 when you take into account the service to restaurants, motels, area headquarter offices for oil and gas companies, company headquarters, local manufacturing service companies, fertilizer plants, better served by the City's water system.

The water supply areas that furnish water to the City are usually referred to as the North Water Field and the Southwest Water Field. The City of Woodward presently gets approximately 30% of its water from the North Water Field in what is known as the Upper Unconsolidated Terrace Deposits along the north side of the North Canadian River and production from this water field began in approximately 1911. The

Southwest water field is where the City acquires 70 to 75% of its present water supply and the rods from the Ogallala Aquifer formation of the High Plains.

The Southwest well field area composes parts of the Western one-third and the Southwest one-third of Woodward County and has been furnishing a major part of the City of Woodward municipal water supply since 1963.

The area described is underlain by the Ogallala formation and is widely known for its water bearing properties. This is the central portion of the high plains area and the Ogallala formation was derived and layed down from erosion from the central Rocky Mountain area in the latter part of the tertiary, by streams from the Rocky Mountains. The Ogallala is one of the most valuable acquifers in the United States, ranking among the first in quantity, quality and developed area. The formation itself is composed of and is described as being poor to unconsolidated deposits, lenses and stringers of sand and gravel irregularly distributed.

The development in Woodward County was relatively untouched until 1965 when the City of Woodward developed a large area. Development of agriculture irrigation has peaked at the present time, due in large part to the depressed farm prices and cattle prices that farmers and ranchers are experiencing, the increased energy cost, ^{and} ~~the~~ the land character of Woodward County. There is some irrigation in Ellis County, and most of the irrigation water for the Oklahoma and Texas panhandles and western Kansas is taken from this acquifer. Most of the cities and towns in this area use this as a source of municipal water supply.

The towns of Arnett, Oklahoma, Shattuck, Oklahoma, Gage, Oklahoma, and Fargo, Oklahoma, obtain water from this aquifer for their supply. In the early 1940's the United States Air Force did some limited testing for water in and around the West Woodward air field and Tangier, Oklahoma. During July of 1964, the City of Woodward, Oklahoma, initiated a test program for this area which included area surveys, test hole drilling, elevations and test pumping of existing water wells developed by the United States Air Force and presently owned by the City of Woodward, Oklahoma. A total of 78 test holes were drilled to the red bed, samples and well logs taken, and the water surface and land surface elevation measured. Depths of the test holes varied from 185 feet to 332 feet; and, subsequent to said testing, available test hole logs were published, including data and drillers' information, numbering approximately 131 logs and covering an area of eleven (11) townships and including detailed drilling of 117 sections.

The area described hereinabove affords little runoff due to the sandy, porous, rolling and flat areas which tend to collect and hold any precipitation. There is approximately eight (8%) percent farm ground in this area with the remaining surface being primarily used for ranching.

The Ogallala aquifer is a basin of water which discharges naturally through plant transpiration, springs and streams flowing out from the area described above. Streams that flow in dry weather in the immediate area are Wolf Creek, North Canadian River, Indian Creek, Persimmon Creek, and all of said stream flow is produced primarily and solely from the Ogallala Aquifer formation. The existing water production

rates, levels and wells show that this area is capable of producing continual sustained yields at the present time. The City of Woodward, Oklahoma, made an inspection prior to today's hearing of its existing water well levels in what is known as the Southwest Water Field.

HIGH PLAINS STATES' GROUND WATER DEMONSTRATION PROGRAM
ACT OF 1983

The City of Woodward, Oklahoma, has had an opportunity to review the report issued by the Committee on Interior and Insular Affairs as submitted by Mr. Udall from the House of Representatives on May 16, 1983; and, in addition thereto, accompanying bill HR-71 and its identical counterpart which was introduced in the Senate, S-1811, which was introduced by Mr. Nickles, Mr. Exxon and Mr. Zorinski on August 4, 1983, in the United States Senate. The City of Woodward differs with the Administration as set forth in the letter of November 7, 1983, by Assistant Secretary, Garrey E. Carruthers, in the following respects:

1. The City of Woodward believes that both Phase 1 and Phase 2 of the program should be passed in the original bill;
2. The City of Woodward does not believe that Section 2 of the bill should be omitted with respect to specific language wherein "the bureau shall consult with the United States Geological Survey and other appropriate agencies and departments of the United States and of the High Plains states and other Reclamation Act states in order to carry out this Act", primarily for the reason that the word "shall" guarantees the input from local entities and states and believes that this specific language should be kept in the bill primarily to insure

that the Federal agencies will be required to consider local input and state input into the final report that would be produced in five (5) years; the City of Woodward is fearful of Section 7 of the bill primarily for the reason that it is the understanding of local counsel for the City of Woodward that Section 7 would necessitate the City of Woodward, Oklahoma, a municipal corporation, to ~~be paid~~^{pay} to the Federal Government the cost-sharing formula for work done under the parameters of this bill in the approximate amount of \$20,500,000.00, in the following formula: for every one (\$1.00) Federal dollar the State and local dollars shall amount to four (\$4.00), as set forth by the Assistant Secretary for the Department of the Interior, Garrey E. Carruthers, The Administration, in a letter dated April 25, 1983, to Chairman Morris K. Udall of the House Interior and Insular Affairs Committee, recommends that the cost-sharing formula be deleted and that in place thereof, that a cost-sharing policy be imposed as later developed by the Administration. The City would oppose deletion of the Federal cost-sharing basis at the present time; and, the City is aware, as well, of the in kind services that can be given credit to it and in view of the present bill, in kind services wouldn't allow maximum use of data, planning studies, technical resources and assistance from local entities to the Federal Government for this bill, and studies in the past should be allowed to be counted as well which are utilized in the Ground Water Demonstration Program Act of 1983.

The City of Woodward, Oklahoma, believes that it is imperative that this study take place, that as set forth in previous testimony, the City of Woodward, Oklahoma, retains one hundred (100%) percent of its water supply for the citizens, industries, commercial and other

facilitates from ground water and said water supply is the life blood to the existence of the City and its potential for growth. In addition thereto, the agriculture industry, as represented by the farmers and ranchers of this area is dependant upon the Ogallala Acquifer for its existence and ^{the} study could help garner any research and development needed to insure that the Ogallala Acquifer is not depleted in the coming years. The City understands that this bill is a research and development bill and it is not, per ^{se} ~~many~~, a problem solver, but the City would strongly urge that as part of research and development the effects of pollution, chemical, salt water, and any other type be included as part of this research and development for the fact that ~~damage~~ of the Ogallala Acquifer would cut short not only the life blood of the City of Woodward, Oklahoma, but of the existence of farmers and ranchers throughout the high plains area and represents the single greatest risk to the survival of the farming and ranching industry, agriculture industry and the City itself.

The City of Woodward, as of February 14, 1984, can state that it would not qualify for demonstration project due to the fact that there is presently not significant declining water table in the Ogallala Acquifer and under the terms of the bill that has been passed by the House and that Senator Nickles has introduced before the Senate, the first criteria could not be met by the City of Woodward or the adjacent land in the County of Woodward, but the City of Woodward supports the panhandle counties of the State of Oklahoma and, in particular, to Texas County for a potential demonstration project, as set forth in the bill that has been passed by the House of Representatives and is now before the Senate due to the fact that the City knows, on a factual

basis that there is declining water table in the Ogallala Acquirer, that there is an available surface water supply in the area, and that in addition thereto, there is a high probability of physical, chemical and economic feasibility for recharge of ground water reservoir.

The City hopes that Senator Nickles and Senator Boren, as well as Congressman English, would, if this bill should pass the Senate and be signed into law by the President, urge that a demonstration project be provided to Texas County because of the factors listed hereinabove and for the further fact that surface area of Texas County has lent itself to agriculture irrigation for vast areas of Texas County and potential recharge research and development would, in the end, beneficially effect the City of Woodward because of the transmissibility of water from Texas County, State of Oklahoma, into the Southern reaches of the aquifer such as Woodward County.

The wells of the City of Woodward in the Ogallala water field are presently at the depths of 95 to 150 deep. The pumping system that the City of Woodward employs to get the water from approximately nine to twelve miles south and southwest from the City of Woodward utilizes electricity. The City has experienced from January, 1983, to January, 1984, an increase of thirty-eight (38%) percent in the bill that the City of Woodward pays for electricity to Oklahoma Gas & Electric Co., and the bill that the City of Woodward pays to Northwestern Electric Cooperative. January, 1983, to January, 1984, has experienced an increase of eighty-seven (87%) percent. The City of Woodward, from

January, 1983, to January, 1984, paid an amount of \$103,955.16, to Oklahoma Gas & Electric Co., and from January, 1983, to January, 1984, paid to Northwestern Electric Cooperative, the sum of \$153,392.82. It is therefore critical, not only for the City, but to the citizens of the City that the water table of the Ogallala Aquifer contain itself at the present level here in Woodward County, as a decline in the water table of the Ogallala Aquifer would increase the cost of pumping from the Ogallala Aquifer to the City for distribution to its citizens, not even taking into effect the normal increases that would be granted to utility companies which would normally be passed on to the City as a purchaser of electricity.

It is easy to understand why it is so cost prohibitive for the agriculture industry to utilize electricity for irrigation when the prices for its available products, such as cattle, wheat are at such depressed levels. The agriculture industry is an integral part of the economy and viability of the City of Woodward and the City and its citizens suffer from the present depression that both the farmers and ranchers are experiencing in this area. Plants are dependent upon the agriculture industry needing to acquire fertilizer for its products as well.

The City of Woodward employs the recycling of its treated sewage facility effluent which is a demonstratable conservation measure and produces added benefits to the Ogallala Aquifer in view of the fact that the City reduces the amount of water taken from the Ogallala Aquifer and this conservation measure is presently being used on one

of the golf courses where said treated water is used to irrigate the course itself and plans are presently underway to include a further extension of this method of conservation and recycling to include park areas within the City itself along with the golf course that is located at Lakeview and Downs Avenues, and would result in a direct savings to the City of two to four water wells. The City, in essence, is utilizing recycled ground water to irrigate and enhancing the recharge of the water supply and water resource in the Ogallala Aquifer. The City employs a policy that insures that these wells are not overpumped which insures that the Ogallala Aquifer is not depleted at an unnecessary rate by the City itself, has enacted a policy which over a period of some twenty years has produced

meters have been placed on all wells to insure correct flow at the well head of the water taken from the Ogallala Aquifer which are at an advanced state of technology at the present time; and, in addition thereto, checks for pollution of the aquifer on a periodic basis are taken.

CONCLUSION

The City of Woodward, Oklahoma, strongly urges the adoption of a special study of the potential ground water recharge in the high plains states, and effects of pollution both present and future, as set forth in HR-71 and S-1181 with the suggestions stated hereinabove for the reason that there is no more necessary element for the continued existence of the City of Woodward and of its citizens than water nor of critical element of the economy of the City of Woodward and this area of the State of Oklahoma, the agriculture industry. This

bill, if signed into law, would provide research and development which would enhance the ability of human beings to make intelligent decisions about the Ogallala Aquifer which would insure the existence of farmers, ranchers, citizens and cities themselves within said aquifer. The City of Woodward urges the adoption and inclusion of the pollution portion of research and development on the aquifer itself based upon previous testimony that pollution of the Ogallala Aquifer represents the single greatest threat to the water supply itself. In addition thereto, the City urges that a demonstration project be located in one of the panhandle counties of the State of Oklahoma, and specifically has cited the example of Texas County, State of Oklahoma, because of the necessary criteria as set forth in the House report, HR-71, and the elements as all being met therein. The City would urge that the past studies and data as set forth hereinabove be counted as input for "in kind services that a local entity can provide" purposes of reimbursement to the Federal Government for the study and the City's testimony is based upon the fact that at the present time a decline in the sales tax of the City of Woodward, which is the major income producing method for funding of the City itself, would prevent the City of Woodward from adopting any new necessary expenditures. Within the last year, the City of Woodward has passed bonds in a sales tax for the creation of an approximate 90 bed hospital at the cost of some \$15,000,000.00; and, in addition thereto, is working with the environmental protection agency to expand the present sewer system of the City of Woodward at an approximate cost of \$1.3 million dollars, while at the same time insuring the present level of services to the citizens of Woodward that they have experienced. City Engineer, G.E. "Gene" Myers of Myers Engineering has worked for the

City of Woodward since 1958, a period of some 26 years, and has over this period of time suggested policies which have been adopted by the City of Woodward's Commission which employs knowledge of the Ogallala Aquifer, its problems and the need for conservation and the employment of conservation methods themselves in the implementation of the water system throughout the City of Woodward. The City of Woodward strongly urges the adoption of the bill presently before the Senate and signing into law by the President of the United States. We appreciate the opportunity to have testified before you today.

Senator NICKLES. Thank you, Mr. Myers. We appreciate the panel's statements.

Mr. Lucas, you made some pretty direct comments and Mr. Sullivan, as well, I appreciate the work that you all have done. We have got some work to do, and I would agree that we are not just looking at the studies. We need to try to figure out what we can do. I would agree, that there are a lot of problems if you start talking about water transfer and reservoirs. This bill is something that can be done. I think we will be able to get it passed. Hopefully, we will see some positive results. We will look into areas and some of these new techniques. Maybe some of our committee panels will be able to give us some better idea of the things that have been happening.

There are some new technologies that people have been studying, more in the private sector than in the public, in many cases. Maybe we can take advantage of some of those experiences. If you look at the total amount of depletion, in some cases the ratio is 2 or 3 to 1 in relationship to recharge that we are not going to be able to solve that problem overnight. That is a pretty significant difference, but it's one that we need to work on to see if we can't enhance the projection of recharge. Those of you here in Woodward maybe are not in that bad a shape, but if you go a little bit further west in Beaver County, you find the problems are much more significant. That's the reason why we are having the hearing out here instead of Washington, D.C., where they have plenty of water.

So thank you very much for your statements.

Next we have Dr. James Osborn, professor and head of the Department of Agricultural Economics, Oklahoma State University and also, Dr. Robert Knox, environmental engineer, Environmental Ground Water Institute, University of Oklahoma.

Dr. Osborn, you have testified before and have been before our committee in Washington, D.C. I want to thank you for the work that you have done and also the work that Oklahoma State University has done.

STATEMENT OF DR. JAMES E. OSBORN, HEAD OF THE DEPARTMENT OF AGRICULTURAL ECONOMICS, OKLAHOMA STATE UNIVERSITY

Dr. OSBORN. Senator Nickles, I have a prepared statement and request that that be put in the record. I will summarize that with a few comments.

My name is Jim Osborn. I am head of the Agricultural Economics Department of Oklahoma State University. I want to recognize three things that have been emphasized at previous presentations, and I will go through those in detail this morning. I recognize that the Ogallala aquifer is in eight States in the high plains and is an important source of water. I also want to recognize that the Ogallala water formation is finite; that it is being dewatered. We have some instances where we do have increased static water levels. Where overall, I think, the facts do indicate that it is being dewatered because it is finite in quantity and available supply. Third: I want to recognize that recharge has been done in the Ogallala aquifer in certain situations and times that is as technically feasible as it can be done. However, I would like to emphasize and recognize those three points; that there are some needs, and I think three of these needs are approached in the S. 1811; the fourth

one, I believe, is not. I would like to emphasize that one, also, this morning.

I believe the important need that is addressed in this bill is that we need a systematic study of recharge in the Ogallala formation. This can be done with the demonstration project which you are proposing. We do have a large number of studies that are reported. I believe as high as 800 studies of recharge have been reported. But I believe we need to investigate these studies and the work that has been done in the individual cities and towns throughout this area. The second need that I see is that we need to inventory the source of water that could be used for recharge. I believe this is being addressed to some extent at the present time. It is somewhat unfortunate that the Ogallala formation is primarily located in areas that have low rainfall. I guess we really haven't figured out why it was formed that way, but that's the situation. So it's going to require some water—sources of water for recharge. We need some type of inventory to indicate how much is available for these areas. The third need, which is, I believe, somewhat addressed in this S. 1811 is the type of treatment required for recharging water into the Ogallala formation. We do know that the Ogallala formation is not homogeneous. That means that it varies in composition from one area to the other. Not tremendous changes, but there are changes from the southern high plains of Texas to the Oklahoma Panhandle. We do know that this formation will take water of different quantities with solids and materials in it. We know, that, also, that there are some other problems with recharging different types of water according to the EPA regulations—and we have had some of these addressed this morning.

I believe those three items are addressed in this S. 1811 to some extent. The fourth one, however, is not addressed in S. 1811, and that's the types of things that the [inaudible] can do at Oklahoma State University. That is developing some other alternatives that would also supplement the recharge capabilities and also extend the available supply in the Ogallala formation at the present time. One of those areas that I think needs to be approached is touch practices. We have some preliminary work completed at Oklahoma State University that indicates that travel over soil, much periods of times, reduces costs. At the same time we reduce yields to some extent. We also reduce the evaporation of moisture from the soil by doing this.

Another area that I think we need some additional work is the area of crops. We have a work constant of the development of new crops of varieties, and we know that there are some crops that use much less water and can produce essentially the same yields.

One area that I am particularly interested in is economics. Importation of water, recharge of water, and use of water by farmers will ultimately depend upon economics. I was told at one time by a chamber of commerce that the cost of water is not important; we must import. We know that's not true. Economics is the final decision, regardless. So we need to be able to put some type of economic perimeters on recharge as well as other types of studies.

We have discussed a great deal this morning and in the past about conservation of water, but much of this has been lip service. We know that we can produce. Studies at Oklahoma State University indicate that we can produce the same yields of crops in the high plains of

Texas for a third less water by using some of the accepted means of determining water needs by the crops and even by the direction the rows go in the fields. So there is some new alternatives available on these four areas that can be used to conserve the use of water at the present time.

With the farmers being caught between the squeeze of declining water levels and increasing energy costs, it is very difficult to continue irrigation if you are faced with both of these vices coming in at one time.

So many studies that are done in situations like this, particularly natural resources, are done after natural resources are depleted. I believe with S. 1811 we have an opportunity to impact upon western Oklahoma as well as the other seven States. This is the main reason that I am strongly supporting S. 1811. I believe it gives some alternatives and opportunities to the people in these States for future use of these natural resources.

[The prepared statement of Dr. Osborn follows:]

STATEMENT BEFORE THE SUBCOMMITTEE ON WATER AND POWER
OF THE SENATE COMMITTEE ON ENERGY AND NATURAL RESOURCES

IN SUPPORT OF S. 1811

PRESENTED IN WOODWARD, OK, FEBRUARY 17, 1984

BY JAMES E. OSBORN

HEAD OF DEPARTMENT OF AGRICULTURAL ECONOMICS

OKLAHOMA STATE UNIVERSITY

My name is James E. Osborn. I have a Ph.D. in Agricultural Economics at Oklahoma State University. I have worked as a professional Agricultural Economist at North Carolina State University, Auburn University, Texas Tech University, and Oklahoma State University. While I was employed at Texas Tech University, I was also a joint employee with Texas A & M University.

I have completed research work on the economic impacts of the Ogallala on farmers and the economy of the Southern High Plains of Texas. In this work, I was concerned with the economic impacts of a declining groundwater supply on farmers and the regional economy in West Texas.

My position at Oklahoma State University includes management of programs in three areas: Teaching, Research, and Extension. Programs are conducted in Farm Management, Marketing, Agricultural Policy, Natural Resources and Rural Development.

Oklahoma State University is a multipurpose university. In addition, it is the Land Grant University in Oklahoma with the Oklahoma Agricultural Experiment Station and Oklahoma Cooperative Extension Service as two of its units.

Oklahoma is an agricultural state with approximately 71,000 farmers and ranchers. Agriculture is second only to petroleum as a source of income to Oklahoma. There are approximately 34 million acres of land in farms with an estimated 15 million acres in cropland. Approximately 80% of the value of production of crops and livestock in 1982 was received from these commodities: cattle and calves (44%); wheat (30%); and hay (6%).

Over 900 thousand acres of cropland are irrigated with approximately 495 thousand acres being irrigated with groundwater from the Ogallala aquifer. The Ogallala formation in Oklahoma is primarily located in the 10 northwestern counties. The formation extends to 7 states in addition to Oklahoma in the Great Plains area.

Characteristics of the Ogallala make it a unique formation. That is, it is composed of deposited materials such as clay, silt, sand, and gravel, capped by caliche. The deposited materials are saturated with a finite supply of fresh, high quality water. The saturated materials vary in thickness and depth from soil surface to saturated materials. Although the gradient of the formation is from northwest to southeast, the rate of groundwater movement has been estimated to be only about 2 inches per day.

Rainfall (average annual) in the northwestern counties varies from 14 inches in the west to 24 inches in the east. Groundwater

from the Ogallala is used to supplement water from rainfall for producing crops. Recharge to the aquifer from rainfall and irrigation is low when compared to the withdrawal of groundwater. Thus, an overdraft on the supply of groundwater will eventually render economic exhaustion of the source of groundwater. The decline in the static water level in irrigation wells has been reported as much as 10 feet in one year. However, it is more likely to average between 2-3 feet per year.

Groundwater is lifted to the surface with approximately 2,875 wells in northwestern Oklahoma. The wells are primarily powered with internal combustion engines that are using natural gas. Electricity, propane, gasoline, and diesel are also used for energy sources.

Application of groundwater through irrigation increases yields of crops by 2 to 5 times over dryland production. Other complimentary resources with irrigation also contribute to this incremental yield.

Crops such as alfalfa (12%), corn (11%), sorghum (41%), and wheat (34%) are irrigated in this northwest section of Oklahoma. These crops are supportative of the cow-calf and cattle feeding industries in the area. Substantial investments have been made by farmers to pump and distribute water and by cattle feeders to utilize these crops with cattle in feedlots.

The next major crisis in the United States has been predicted to be a shortage of water. This crisis will be highly significant to agriculture in the area which has the Ogallala formation since approximately 90% of the groundwater is used for agricultural purposes. Studies have been completed to estimate this crisis on farmers and

local economies in the Ogallala area. In an agricultural situation when financial and surplus problems prevail, it is difficult to direct attention to improvement of a major natural resource. That is, a study of groundwater recharge in 8 states.

Groundwater recharge research was conducted in the late 60's by several private and public agencies including: Universities, Research Foundations, and Federal Agencies. These studies reported on suspended solids and organic matter in water to be recharged, cycling of pumping-recharging action, characteristics of formation, and pressure needed for injection.

Technology is available for recharge, i.e. drilling well, dual-purpose pump, and energy source. The technique to clarify the water of suspended solids, organic matter, biological elements, and chemicals becomes crucial. In addition, the determination of water quality and formation interactions is necessary for successful groundwater recharge.

Groundwater recharge is not an attempt to solve the groundwater problem of economic exhaustion from pumping. However, it is a researchable problem which will provide additional opportunities for farmers using groundwater from finite supplies.

Groundwater recharge includes an additional expense for the irrigator: the process of storing water in the formation. That is, the farmer or rancher must collect water for recharge, clarify the water, and move the water from surface storage to the dewatered sectors of the Ogallala formation for storage (this movement of water may include pressure by a pump to force the water into the formation.)

Currently, the irrigator is harvesting (mining) the groundwater for purposes of increasing production of crops through irrigation and the associated resources. However, use of groundwater that has been recharged requires an expense to store the water (clarifying and "down-pumping") and an expense to pump the water to the surface.

Although artificial recharge is not a new idea, public interest in this option has been growing at least in part because it appears to be a viable alternative to extend the use of water for irrigation. This growing public interest has created a need to critically examine the technical and economic feasibility of artificial recharge in regions where the significant groundwater use is irrigation. Some authors report over 800 published technical reports on artificial recharge studies.

In addition to the technical studies, some research work has been reported on economics of groundwater recharge. This work has stressed two areas: cost of recharge systems and economics of conjunctively managing surface and groundwater.

Work is needed concerning the value of benefits from artificial recharge. Policy makers have difficulty in determining when, where, and if artificial recharge is a viable option until more is known about potential benefits from groundwater recharge. Benefits from recharge of groundwater occur in two forms:

1. Extending the economic life of the aquifer.
2. Reducing pumping costs by reducing the decline in the static water level.

Types of potential costs were discussed in a previous section (injection and clarification). In addition, it may be possible to purchase water for recharge in some areas.

Since the benefits and costs will occur in different time periods, the appropriate discounting and/or compounding of benefits and costs will be necessary. This option, groundwater recharge, should be given a thorough, systematic, and comprehensive evaluation. It offers several opportunities to farmers, ranchers, and regional economies by extending the economic life and/or maintaining the level of water application on crops..

Surface water is generally not readily available in most areas in which the Ogallala is present. Rainfall and other sources of water for use in recharge are limited in amount. Thus, some planning and evaluation efforts are needed to determine location, quality, and quantities of surface water that could be used for recharge purposes.

Alternatives are available to extend the useful life of the supply of groundwater through conservation and plant genetics. These options include irrigation timing, distribution, and amounts of water, tillage, row spacing, row direction, and varieties of crops that may increase water use efficiency. These alternatives will not substitute for the concept of recharge, but they would supplement and compliment the practice.

Groundwater supplies in the Ogallala are being overdrafted. Groundwater recharge is an alternative to reduce the impact to the eventual economic exhaustion of the supply of groundwater.

SELECTED REFERENCES

- Brown, Richmond F. and Signor, Donald C. Artificial-Recharge Experiments and Operations on the Southern High Plains of Texas and New Mexico. U.S. Geological Survey. Water Resources Investigations 10-73. May, 1973
- Council for Agricultural Science and Technology. Water Use in Agriculture: Now and For The Future. Report No. 95. September, 1982.
- Ekholm, Arthur L., et.al. Adjustments Due to a Declining Groundwater Supply: High Plains of Oklahoma and Texas. Oklahoma Agricultural Experiment Station Technical Bulletin T-142. January, 1976.
- High Plains Associates: Camp Dresser and McKee, Inc., Black and Veatch, and Arthur D. Little, Inc. Six-State High Plains Ogallala Aquifer Regional Resources Study. March, 1982.
- High Plains Associates: Camp Dresser and McKee, Inc., Black and Veatch, and Arthur D. Little, Inc. Summary: Six-State High Plains Ogallala Aquifer Regional Resources Study. July, 1982.
- Oklahoma Department of Agriculture: Oklahoma Agricultural Statistics 1982. Oklahoma Crop and Livestock Reporting Service.
- Schneider, Arland D. Groundwater Recharge Research for the Texas High Plains. Proceedings of the Ninth West Texas Water Conference. Texas Tech University. February 5, 1971.
- Schwab, Delbert. 1981 Irrigation Survey: Oklahoma. Oklahoma Cooperative Extension Service.
- Supalla, Raymond J. and Comer, Dorothy A. The Economic Value of Ground Water Recharge for Irrigation Use. American Water Resources Association Water Resources Bulletin. August, 1982.
- Warren, John, et.al. Area Study: Summary of Oklahoma Results. Oklahoma State University Department of Agricultural Economics. Oklahoma Current Farm Economics. Volume 54, No. 4. December, 1981.
- Warren, John, et.al. High Plains Study-Ogallala Aquifer Area Study. Oklahoma State University Department of Agricultural Economics. Oklahoma Current Farm Economics. Volume 53, No. 3. September, 1980.

Warren, John, et.al Results of the Oklahoma Agricultural and Farm Level Analysis: Six-State High Plains-Ogallala Aquifer Area Study. Oklahoma State University Department of Agricultural Economics. A.E. No. 8191. October, 1981.

Warren, John. The Proposed Cross-State Water Transfer System: Potential Effects on Irrigated Agriculture. Oklahoma State University Department of Agricultural Economics. Oklahoma Current Farm Economics. Vol. 55, No. 3. September, 1982.

Wiegner, Kathleen K. The Water Crisis: Its Almost Here. Forbes. August, 1979.

Senator NICKLES. Thank you, Dr. Osborn. Dr. Knox?

**STATEMENT OF DR. ROBERT KNOX, ENVIRONMENTAL ENGINEER,
ENVIRONMENTAL GROUND WATER INSTITUTE, UNIVERSITY OF
OKLAHOMA**

Dr. KNOX. Thank you, Mr. Chairman. My name is Robert Knox. I am an environmental engineer of the Environmental Ground Water Institute at the University of Oklahoma. In the mid to late 1970's this Nation was faced with a new environmental phenomenon. The phenomenon was ground water pollution. For years we knew that the waste streams from various activities had the potential to foul the air we breathe and pollute our rivers and streams. However, the considered opinion of soil scientists and engineers was that the soil possessed an infinite capacity to retain and/or purify our wastes streams. Almost overnight we found out that that was not so. With increasing frequency, places such as Love Canal in New York, Valley-of-the-Drums in Kentucky, Rocky Mountain Arsenal in Colorado, or Times Beach in Missouri, became household terms. The response of this phenomenon was immediate.

In 1980 Congress passed the Comprehensive Environmental Response Compensational Liability Act or "Superfund." The purpose of this act was to handle the substantial existing and potential threats posed by uncontrolled hazardous waste sites. The U.S. Environmental Protection Agency also got into the act. In the late 1970's, the EPA developed a proposed ground water protection statute for this Nation. In 1979, the EPA also established the National Center for Ground Water Research as a part of its centers of excellence program. The purpose of the Center was to conduct pure and applied research on all facets of ground water quality management, including ground water pollution control and cleanup.

We, at the Center, have also been interested in artificial recharge as evidence by research proposals to the Bureau of Reclamation for developing a method for selecting artificial recharge sites.

Mr. Chairman, we have been faced with the problem of water pollution, and we have addressed it. On the other hand, it has been known for many many years that pumping rates in the high plains States were exceeding natural recharge rates and water levels were dropping. It has also been known for many, many years that overpumping of ground water aquifers could lead to problems with subsidence in the land overlying the aquifer, the intrusion of salt water or brine water under the aquifer. One means of alleviating these problems is artificial recharge. The number of instances of artificial recharge for replenishing depleted aquifers is limited. The more common application for artificial recharge technology at this time is for flushing polluted aquifers. Artificial recharge also represents an attractive water supply. As we all know, the number of sites left are costly and environmentally damaging surface impoundments. However, we do not have to sit idly by and watch excess water flow downstream. These excess waters can be stored in an underground reservoir for future use.

In essence, Mr. Chairman, we address the ground water pollution problem, but not the ground water supply crisis. The reaction of my-

self and my colleagues at the National Center for Ground Water Research to your proposed bill for artificial recharge is: It's about time.

There is a definite need to study all facets of the artificial recharge question from the technical feasibility to the economic viability to demonstration projects.

The point of my presentation here today, Mr. Chairman, is if we don't do something to replenish our ground water supplies, we won't have to worry about polluting them. Thank you.

Senator NICKLES. Thank you very much, Dr. Knox. I appreciate the work that you have done at Oklahoma University and also the work that Dr. Osborn has done at Oklahoma State University. I appreciated also your statements in support for the legislation. Also, Dr. Osborn, I think you made a very good point as far as there are some other things that need to be done in the agricultural community, at the same time, whether it be different utility factors or different methods of conservation. The problems are so large that it's really going to take every effort, and then, the challenge is still going to be before us for a lot of the States in the high plains. Not just in the high plains, but really in a lot of States in a lot of areas that are wrestling with this problem. It is before us right now.

I also appreciate your statement on this legislation. You make a couple of points. One; yes, there have been some studies, but they really haven't gone from some of the theory to actual applications. We have two parts to our bill. One is to see where we are and do a little research investigation. That's phase 1, which we are saying we want to move in a time period of 2 years. Then, also, we want to see some demonstration projects. We want a timetable to get those going as well.

I think you made some good recommendations as far as the need to inventory the sources of water where we might be able to get some recharge capacity and consider some other alternatives as well. So we can possibly incorporate some of the suggestions that have been made by you and some other persons into the report or in the legislation. I'm fairly confident that we will be able to get this legislation through this year. So, hopefully, we won't be—as Mr. Lucas said—just talking and not doing. Hopefully, we will be able to do something that will show some positive results.

Also, Dr. Knox, I appreciate your statements, too. Yes; there has been a lot of concern by people worried about the quality of water. A lot of those concerns have been addressed by legislation, but we need to be looking, also, at the quantity and the resupply. I appreciate the comments that you made. Did you come from Norman today?

Dr. KNOX. Yes, sir.

Senator NICKLES. You drove a long way.

Dr. KNOX. Yes; I met the highway patrol halfway here.

Senator NICKLES. Well, I hope he greeted you with affection.

Dr. KNOX. He wasn't real interested in ground water recharge.

Senator NICKLES. Well, anyway, thank you both for your input and also, Dr. Knox, for the work that you have done. I haven't had a chance to look at it, but we will examine it as well. Thank you very much.

On our next panel we have David Lockwood, Oklahoma Development Association, Mr. Jack Luthi, from the Woodward Chamber of Commerce, Mr. Gene Barby, president of Save Our Water, and Mr. Clyde Kile, Beaver County Irrigation.

STATEMENT OF DAVID LOCKWOOD, EXECUTIVE DIRECTOR, OKLAHOMA ECONOMIC DEVELOPMENT ASSOCIATION

Mr. Lockwood. My name is David Lockwood. I'm the executive director of the Oklahoma Economic Development Association [OEDA]. The OEDA is council for government serving the eight northwestern counties of Oklahoma, directed by lake officials in cities, counties, and conservationists. It's been an association for 12 years. For those 12 years of existence, the OEDA has been very concerned about the depletion of the Ogallala aquifer and its impact upon the region in which the OEDA serves. We have, through regional work programs, worked many hours to inform the public of the potential impact in the depletion of the aquifer and its possible solutions.

I would like to thank you, Senator Nickles, for the opportunity to provide testimony on this matter and also thank you for your interest in the economic lifeblood of the high plains of Oklahoma. I would like to mention the seven high plains States that are under our Ogallala aquifer. OEDA feels that your proposed ground water recharge and demonstration bill was very much a step in the right direction.

As you know, one of the major problems of the Ogallala aquifer is that the Ogallala is being recharged at a very minute rate but being depleted at a much greater rate. With this variation it is easy to see that we either have or will experience major water supply problems in the high plains as the aquifer is depleted. Many people on the high plains that go through the aquifer, recharge through our crucial method, should be part of the solution to aquifer depletion. The OEDA does have one concern that the water quality may be a difficult problem and must be solved if the recharge is successful.

Our additional comments follow that it is an additional part of the solution of the high plains water problem and should not be forgotten.

The six-State high plains Ogallala aquifer study forms down to in order to solve water depletion problems, that efforts must move forward in self-funds, such as improved farming techniques, prevention of run-off, and expanding our economic opportunities. For the reason, that they may need water transfer for it to be economically feasible.

The solution to ground water pollution will probably be a slow and tedious process, but we feel that the lack of response will jeopardize a major source of food and power for our Nation. Again, Senator Nickles, we support your legislation wholeheartedly and also support any issue that can be provided to protect the water quality of the aquifer. We also encourage you to support this information that would help solve the depletion of the Ogallala aquifer and strengthen the economic future of the high plains and improve, most importantly, the Oklahoma High Plains.

Just from sitting and listening, these are additional comments I have, Senator. I grew up on the southern high plains in Texas on a farm. And I can assure you that the problems are there because they've—where I grew up they've ceased irrigating. Not just because lack of water, but also the cost of irrigation and pumping. They were not fortunate there because they didn't have—we did not have saturated figures that allow the areas of the high plains where the Ogallala lies—have three or four times the saturated figures.

My father spent a lot of time obtaining water—surface water to where it supplemented his irrigation or his production on the lands. I personally feel like that that is a very possible solution. I don't know how that will do with injection, but in that area they have a lot of playa lakes, which the Oklahoma Panhandle doesn't have, which show a potential water source, which should be utilized.

I think several points have been made. I want to reiterate that the aquifer has an uneven bottom, and the impact there is very small from one area to the next. It's not like water flows from one place—in a big river where water flows from one place to the other. The impacts are very rarely felt for more than a quarter of a mile from each other.

So, again, thank you for the opportunity to speak.

Senator NICKLES. Thank you, Mr. Lockwood. We appreciate your statement.

STATEMENT OF CLYDE KILE, BEAVER COUNTY IRRIGATION

Mr. KILE. I'm Clyde Kile from Beaver County. What I realize that we need to look into is the water situation as far as ground water is concerned. But the comments that I'm going to make here today is to the excess money—the rate that the irrigators has to pay. I'm not saying that it is right or it is wrong. But that's jumped from the last 20 years from \$0.30 gas to \$4 gas. I happen to know some people south of town—south of Beaver—that's not a big dairy. For several years they've gone on free gas for irrigation wells. Well, that well went dry, and, you know they had supplied about all of its going west—anyways, to Guymon. And this man told me last night that he had to pay a \$2,300 gas bill in 1 month on one well. He said, "We shut them down."

So I think that—I've said for the last several years that the high price gas is going to take care of the water situation. I realize we don't need to forget about the water situation, but as you drive out to the country and see irrigation and circular systems have never moved all summer. And maybe in the following year they will irrigate one time or maybe get the wheat up and maybe one time in the spring. It just seems to me like the high price fuel is going to take care of the water problem.

Several years ago down here in the Pecos Valley when we were paying \$0.30 for gas and it jumped to \$1.85 and they told you to, "Take it or leave it. We don't care." And in 1 or 2 years time the irrigation had dropped from 50,000 acres to 5,000 acres. And I think going back from today, the drawdown on the water in the high plains and the Ogallala aquifer—the big drawdown is being dug by cheap fuel, and we don't have any cheap fuel anymore, and we never will have.

Senator NICKLES. The days of cheap fuel are gone, so you think that a lot of that irrigation is going to be reduced?

Mr. KILE. That's my—we are still lucky that we're still pulling in gas. It's an old well with a set price. And I think whatever it regulates at, it will put us out of business. I mean we irrigate alfalfa—I think it will put us out of business when we have to put up with \$4 gas. I'm not saying whether it's right or wrong—if we can regulate this—because we're looking at it from both sides.

Also, we've got wells that when we do regulate it, we can get a bigger paycheck out of it, but we'll be paying a lot more for gas.

Senator NICKLES. You can see both sides.

Mr. KILE. We are looking at it from both sides.

Senator NICKLES. Well, I appreciate your statement, Mr. Kile.

STATEMENT OF GENE BARBY, PRESIDENT, SAVE OUR WATER

Mr. BARBY. I appreciate the opportunity of appearing before you, Senator Nickles. I am Gene Barby, president of Save Our Water. I wear two or three hats on this issue. I'm a rancher and operate four center pivots. We pump shallow water that is consistent with the high plains. The water table is a part of the Ogallala aquifer.

Senator NICKLES. Where are you?

Mr. BARBY. Pardon me?

Senator NICKLES. What county are you from?

Mr. BARBY. I ranch in Beaver County.

Senator NICKLES. Beaver County?

Mr. BARBY. Yes. I operate a 21-section ranch. I'm also a geologist in the oil business. So from those two positions and the position of Save Our Water, I would like to endorse what Mr. Kile has said. As far as the short-ranch problem, I think the energy crisis has solved the rapid drawdown of the Ogallala. Certainly, any deep wells are being shut in, and as the water table declines, of course, the deeper you have to go to pump it and the more expensive the operation. So maybe those center pivot operations have been turned around and been put back to dry operations.

However, long term, I think your proposal is admirable for two conditions. I think they are very important conditions. One is so as opposed to the basin-to-basin transfer of water—and this is part of the regulations in Oklahoma—perhaps, it's not been enforced too well, but I think you should make a part of your bill the fact that one basin in Oklahoma should not suffer at the expense of another or not profit at the expense of another. In other words, let's don't pump water from Hoss Basin in southwestern Oklahoma to improve the Ogallala. We would not be opposed to the transfer of water from, say, a free-flowing stream headed for the ocean, which would be wasted—polluted by ocean water. But we would be opposed to transfer of ground water from one basin to another to enhance the Ogallala.

Senator NICKLES. What if there were some aquifers recharging at a rate of three or four times to one of what they were actually using?

Mr. BARBY. Then, if the water wasn't needed, we would have no opposition to it.

Senator NICKLES. We are talking about technologies that I don't think are necessarily there.

Mr. BARBY. I don't know of any such basins in Oklahoma.

Senator NICKLES. You're talking about some areas that studies have indicated have substantially more recharge than there was actual usage.

Mr. BARBY. Then, if there is an excess of water, I would not think that anyone would suffer from transfer.

The other point that I would like to make, and I think it should be a part of your bill, I think you should deny funding to any State that allows freshwater to be used for the injection in secondary or tertiary

oil projects. This is a total complete waste, and there are several freshwater injection programs ongoing now in the Ogallala. I know of two in Texas County, and I am told that there are some in Beaver County.

Senator NICKLES. So they're obtaining freshwater from the Ogallala and using that for—

Mr. BARBY. For self-surface injection to enhance oil land terms. The point here is that saltwater is plentifully available. It's a little more expensive to these oil companies, but they choose instead to use freshwater at the expense of the Ogallala Reservoir.

Senator NICKLES. How much of that is actually happening?

Mr. BARBY. The last I knew there was some 64 known freshwater oil floods in the State.

Senator NICKLES. You mean in the whole State of Oklahoma?

Mr. BARBY. Yes. You may remember that Senator Tim Leonard tried to pass a bill some 4 years ago outlawing the use of freshwater for secondary or tertiary recovery. Although the bill passed in the Senate, it failed in the House.

Senator NICKLES. You say 64 wells in the State of Oklahoma?

Mr. BARBY. Sixty-four floods would be many wells involved. Now, this was reported during the testimony at the time of Senator Leonard's bill.

Senator NICKLES. Let me make sure. You said 64 floods?

Mr. BARBY. Yes.

Senator NICKLES. How many wells are they taking freshwater and trying to—

Mr. BARBY. I don't have that figure at hand. I'm not sure if it's available.

Senator NICKLES. Sixty-four different areas where they are trying to flood existing, depleting reservoirs trying to enhance the recovery?

Mr. BARBY. Yes, sir.

Senator NICKLES. Using freshwater?

Mr. BARBY. Using freshwater.

Senator NICKLES. Are the great majority of those using saltwater?

Mr. BARBY. The great majority of floods in Oklahoma do use saltwater, but some companies chose to use freshwater because it was cheaper. One excuse is that—at least as far as tertiary flooding—that the chemicals being used were incompatible with saltwater. So they had to go to the wasteful use of freshwater. But there has been some new discoveries made. One by Texaco where they can either clean up the saltwater or use chemicals that are compatible with it.

Senator NICKLES. Has the problem been more with small operators, or are you talking about major operators?

Mr. BARBY. I can site you two top oil companies that are using freshwater and flood in Texas County. One is Mobil Oil Co., and the second one is Cities Service. So it's not just—it covers all respects of oil companies.

Senator NICKLES. I appreciate your testimony, Mr. Barby. I remember Senator Leonard talking about that. Has that been approached? I can tell you have done a lot of homework. What does the Oklahoma Corporation Commission say about that?

Mr. BARBY. The corporation commission as far as I know, takes no stand with it. Actually, it falls under the responsibility of the water

resources board. Unfortunately, the water resources board even has—conducts certain conditions that can be met to allow companies after a hearing to use the water.

Mr. KILE. They've OK'd that down there a time or two, haven't they?

Mr. BARBY. Absolutely. In fact, they've almost enforced it.

Senator NICKLES. Well, we have an official from the Oklahoma Water Resources Board who will be testifying shortly.

Mr. BARBY. I hope you will be getting into that with him because, perhaps he can tell you how many—exactly how many known floods there are at this time. I only have the figures that are 4 years old.

Senator NICKLES. Well, I appreciate your support of the legislation, and I also appreciate your testimony and suggestions. That's one of the reasons we have hearings. I can tell you that very seldom has there been a perfect piece of legislation. As a matter of fact, most of them are imperfect. Some of them are terrible.

Mr. BARBY. You have a golden opportunity here to make the State of Oklahoma clean up their act, is what I'm saying.

Senator NICKLES. I would assume that if this is happening in Oklahoma, it's probably happening in lots of other wells—

Mr. BARBY. I would assume so. I hope not, but it's unfortunate that we have any. Once that water goes into an oil formation and is mixed with oil and saltwater, that depth is totally lost from our sight and gone forever.

Senator NICKLES. I appreciate your comments, Mr. Barby. Thank you.

STATEMENT OF JACK LUTHI, WOODWARD CHAMBER OF COMMERCE

Mr. LUTHI. Thank you very much. My name is Jack Luthi and I am representing the Woodward Chamber of Commerce here today. However, I was previously the city manager here at Woodward for about 6 years. In 1977 a cardiologist helped me decide that I should quit that job. Prior to that I was in the service for a full career. In the service I wasn't too concerned about water and other concerns, but when I became city manager here, it became very obvious to me right quickly that water was a real issue and one that we needed to address ourselves to. And so I did.

As has been said before, I think we in Woodward, perhaps, are not the best example of the criticality of the Ogallala formation. Because we really haven't—at least at the present time—had the problem and drawdown that I think they have in other places. But I think there is two reasons for that. That, perhaps, aren't pertinent to others. No. 1 is that we have another aquifer—the so-called river aquifer—where we have some 36 wells here for Woodward which is not concerned with the Ogallala. On the other hand, we do have some 32 wells out of the Ogallala formation. In other words, we have almost 70 wells serving Woodward. The other one is, of course, we do not have the degree of irrigation that they have in other parts of the area where the Ogallala serves. And that, of course, is very important to us here.

But I think in spite of that, we in Woodward are very concerned about water. When I came here they had about 7,000 acres of water

rights. During the time that I was city manager, we acquired 10,000 more acres. So we have about 17,000 acres of water right here now. And we did that because we recognized the ultraimportance of potentate water for the area.

I would like to give you, maybe, two examples that might be useful in these hearings of how important water is. One pertains to the W. R. Grace Co. that came here in 19—they started operation in 1977 producing a fertilizer, the Oklahoma Nitrogen Co. I was in the negotiations with the W. R. Grace Co. for their coming here to Woodward. They, of course, are—I guess—the largest industry in terms of investment that we have ever had in this area.

But the real primary concern with this industry was water. And they require on the average about 2 million gallons of water a day. And I can say that the negotiations many times almost came apart because of the issue of water. We, recognizing that this would be a great impact on us, and they, recognizing the absolute necessity of it if they were to have the industry.

Of course, finally, we were able to work it out and get together. But they use about 2 million gallons of water a day. So in addition to agriculture, industry is extremely important. And at that time—I think it is still city policy—that we in the future realized that we would have to be very careful—any future industry that uses that much water, and if they used water like this industry, we would have to take a long look before we could think of bringing them in and being a part of our society.

And the other example that I think is important is during the time I was city manager we acquired about 4,000 acres of water rights out north of town. That's not in the Ogallala. That's in the other formation. And at that time the Oklahoma Water Resources Board gave a temporary permit for 2 acre-feet of water per year. The residents of that area—the ranchers—became very concerned. So concerned that they introduced in litigation to cause this amount of water—2 acre-feet—to be reduced. They hoped to one-half acre-foot. And I think the final outcome was that it was reduced to 1 acre-foot per year and the city has not put down a single well out there, yet.

But, again, I think it emphasizes the importance of water to the landowners, to the ranchers, and to the community or the city of which, of course, we represent. So even here in Woodward, where the problem is not that acute, it is a real problem and will be a real problem for the future growth of this community as we look down the road.

I think that's the extent of what I had to say.

Senator NICKLES. Thank you, Mr. Luthi. I appreciate your comments. I think they are well taken and important, too, because you do tie in the fact that in the industry we have to concentrate most of our remarks on agriculture. I think everyone recognizes that water is critical to agriculture, but it's also critical in industry, as well.

Mr. LUTHI. Excuse me, Senator. I think, too, and it has been said before, but I think another factor in this whole thing is the matter of conservation. I think we have done very little in conservation. I often use the example—it's rather trivial, I suppose—but go into any restaurant in this area. Go to any city club. The first thing that you will see is every glass is full of water. When the people leave, 80 percent are still full. They are tossed down the drain. We absolutely are not ebb in

terms of conservation. In watering our yards, I can go down the streets of Woodward and see water running down the gutter all over town; people watering their yards. We have not learned yet, the meaning of conservation. I think conservation is just as important as replenishing our supply.

Senator NICKLES. Good point.

Mr. KILE, this is just a quick comment. You mentioned that you felt like the high energy prices were going to mandate conservation or mandate—they're just going to—they're just uneconomical, particularly for wheat, some feed grains, as far as irrigation in, say, Beaver County?

Mr. KILE. Whether you go in the way of \$40 to \$120 a day in fuel, well, I just don't think you can operate like that.

Senator NICKLES. Well, I wouldn't think you could for wheat. Has the price of feed grain gone up to where maybe—

Mr. KILE. Alfalfa is actually the only thing in the last several years that's advanced in price. I know when I started out it was \$20 or \$25, and now it is \$100 or \$110. Well, that puts quite a boom on that, you know. But alfalfa is a lot of work, and it takes a lot of water. But wheat and grain—wheat and feed grain is not any higher now than whatever it was 10 or 15 years ago. So that, you know—it just about puts it out.

Senator NICKLES. One comment. You mentioned that some of it was dryland farming. I've been out in the panhandle several times. Looking at where the aquifer is and through the Oklahoma Panhandle, the Texas Panhandle, and on up into Liberal and Garden City and in that area, a lot of time you can see the green of irrigation, and you see some real production. You see no irrigation, you see no production. I mean some of that area is not going to have hardly any production on dryland farming; am I right?

Mr. KILE. That's right. And I told a man last night on the phone. He made a remark—he drove up northwest—he said there was more irrigation used on north of Liberal, Kans., than what there was when they got into Kansas and went on west. He said that they just wasn't running the irrigation.

Senator NICKLES. So that area, particularly when you get up in that western part, you just don't see hardly any agriculture production as far as irrigation. I guess that is the most common type out in that area?

Mr. KILE. That water that's being drawn, it is from the Ogallala formation. I mean we are down close to the river, and our wells are shallow. And we haven't had any drawdown. I think they tested them last winter, and we didn't have any drawdown. But, of course, there's not any wells that—

Senator NICKLES. Could you give me an idea of what the reduction has been in irrigation, in your county?

Mr. KILE. Well, I couldn't tell you. I mean, all of our wells right on the river, there, there hasn't been any drawdown. But, of course, there's probably only a half a dozen wells up and down the river for maybe 15 or 20 miles—maybe farther than that. When you go back in south, maybe on the flats there are some of them. But the wells are not thick around us.

Mr. BARBY. I would like to add that in Beaver County we don't have the concentration of irrigation that they do further west of Texas County or in the further north counties. But we had a unique

thing happen in Beaver County that is worth mentioning. Our water table actually rose in the Ogallala for 1 or 2 years, by actual measurement.

Senator NICKLES. In the last couple of years?

Mr. BARBY. Yes. I believe water resources board can give you the exact dates.

It was probably because of the increased rainfall over the last 2 years.

Senator NICKLES. How much rainfall have you had?

Mr. BARBY. It was abnormal—what—probably 10 inches?

Mr. KILE. I would imagine.

Mr. BARBY. That, in effect, provides your recharge for the water.

Senator NICKLES. Gentlemen, I appreciate your comments. I'm thinking, too, of the record, though, statements where you say, "Yes, we had a pretty rough year."

When you have someone from Washington, D.C., reading this, and they don't understand what it's like in Guymon, Okla., or Garden City or some of these other places. Their concept is entirely different.

I remember last year when we had drought, and we were going through Iowa and Indiana and some of those places. Yes, there was a drought, particularly, compared to what they have had in the past. But there wasn't a drought as you and I know a drought. There's a real difference. They still had a yield in corn. When we have a drought, you don't grow corn. So you can see the difference—there's a little bit of difference in concept of when we have what we call a good year out in western Oklahoma. What they call a dry year, we would consider a pretty good year as far as rainfall is concerned. It's just a little bit different perception across the country.

Anyway, thank you very much for your comments.

Our next panel we have Frank Moore, Oklahoma Farm Bureau, Ben Saunders, Colorado Ground Water Districts, Miss Barbara Buchheit, Guymon Community Development Director, and the Honorable J. D. Braley, mayor of Guymon, and Jerry Shannon, city manager of Boise City. Who cares to be first? If you would pull that microphone right up to you. That way our reporter can hear, and all of the people in the back of the room can hear your comments.

STATEMENT OF HON. J. D. BRALEY, MAYOR, GUYMON, OKLA.

Mr. BRALEY. OK. First, Senator, I would like to thank you, personally, for this opportunity to come before you on this legislation. At the outset tell you that we are glad to see it, and we'll do everything we can to assist it.

Senator NICKLES. Could you give us your name and where you are from?

Mr. BRALEY. I'm Jack Braley, mayor of Guymon, Okla. I have a little statement that I would like to read.

The city of Guymon, as well as other cities in the Oklahoma Panhandle are virtually interested in the issue of water. The Ogallala aquifer has made our region one of the most productive agricultural areas in the Nation. Declining water levels, resulting in decreased agricultural production have a direct bearing on our economy. According to the U.S. Geological Survey, the largest area of water level

decline exceeding 100 feet occurs south of Guymon in Texas County. Recent wells drilled by the city of Guymon for municipal water supply have been only marked on the production compared with those drilled a few short years ago.

We are extremely interested in any solution to the water problems being experienced in our area. Whether that be recharge of the aquifer, water transfer development of surface water impoundments, or water conservation measures.

The city of Guymon and six other panhandle cities are negotiating at this time with the Corp of Engineers to do a feasibility study for the development and distribution of a system from the Optama Reservoir to serve as a source of municipal water supply for the towns. Formation of the Optama Water Development Authority will help the water problems only if the feasibility study proves this type of distribution system to be affordable, and if the lake does, indeed, impound sufficient water to serve the towns involved in the authority.

I might add right now, it doesn't have much water in it.

Senator NICKLES. I was going to ask you, Jack. I'm looking at the picture of the Panhandle, and I see the reservoir. And I have been out there and flown over that, but I haven't seen a whole lot of water out there.

Mr. BRALEY. There is very little and it's depleting. It's evaporating much faster than it's coming into the area—it seems to be. We just haven't had enough rainfall in the Beaver area and Coldwater, which it compounds to accumulate any water at all.

Senator NICKLES. Do you get any water out of it now?

Mr. BRALEY. No; none at all. There was a provision made when the dam was built for municipal attachments, you know, to pull water out of there. And that was part of the feasibility study done years ago when they finally decided to start the project.

Senator NICKLES. Does the city of Guymon get all of its water from ground water?

Mr. BRALEY. We have some 15 to 16 wells, yes, sir. And we've noticed drawdown. Guymon, geographically, I think if you will look—I'm talking about just geographically—it's pretty close to the center of this. You know, in the Texas Panhandle, Oklahoma Panhandle, and southern Kansas, of course, it goes on up here in the Nebraska area. Mr. Kile talked about the economy awhile ago of irrigation. And that is a problem in our area. As the aquifer depletes, it costs more and more for the agriculture and the irrigators to produce their feed grains and corn and wheat.

Also, there was a comment made awhile ago about the pivot irrigation. I want to add this and get it in the record; that in Texas County—I do not have any figures on it, but I know there are millions of dollars' worth invested in underground irrigation pipe, which is probably the most, you know, conservative manner that you can irrigate. Also, there has been millions of dollars invested in tailwater pits. That is where they catch the water, the excess water that's from irrigation, and then pump it back onto the crops. So those conservation measures have been taken. And I have a lot of good friends who are in the agriculture business. And their concern is that, as they alluded awhile ago, to the cost of energy; as well as you know, lifting that

water up and using it for crops. Of course, the feed grain price has affected more of them than anything right now.

Senator NICKLES. As far as reducing the amount of irrigation, you've got a couple of things working against it? One: Prices were low for agriculture commodities and energy prices are up?

Mr. BRALEY. Energy prices are high and other prices are low. I've heard several—we've discussed it—and several of them are cutting back trying to find new methods of irrigating, you know, running water over glass and different ways of farming.

I want to close by saying any steps that need to be taken to assure an adequate water supply in the Panhandle are of vital interest to us. This water and its availability will have a direct impact on the economy or our community and to sustain life in our area. And it is very important, we being in the high plains area, that we have water. And we appreciate your concern. We would like to invite you to come out and look us over.

Senator NICKLES. OK. And we'll do that. I appreciate your coming over to join us in this hearing today.

Mr. BRALEY. Thank you very much.

Senator NICKLES. Did you see on national news where Bryan Gumble mentioned Hooker, Okla., yesterday?

Mr. BRALEY. Yes; I did.

Senator NICKLES. We appreciate that attention. It may have been mentioned for the wrong reasons, but we still appreciate it. I was really tickled.

Go ahead, Miss Buchheit.

STATEMENT OF BARBARA BUCHHEIT, GUYMON COMMUNITY DEVELOPMENT DIRECTOR

Miss BUCHHEIT. I am Barbara Buchheit from the city of Guymon. In addition to the mayor's comments, I would like to commend you on your efforts for seeing that we have ground water available in western Oklahoma. One other thing that I would like to say, too, is to encourage your committee to support other Federal legislation that encourages reuse of ground water. We are involved—or on the drawing board with plans to go to land application of sewage implement, directly tied to the EPA's innovative and alternative program for sewage treatment. Funding for that program has been critical and will be critical to us. When we get the program going—provided funding is there—we will be reusing 1½ million gallons of water a day that we won't be pulling from the aquifer. So any Federal legislation that would be tied directly to water reuse and conservation measures would also help the problem. And that's about really all I have to say.

Senator NICKLES. Are you doing that now?

Miss BUCHHEIT. We are just on the drawing board with it.

Senator NICKLES. So you're planning a treatment project where you could treat it and then reuse it?

Miss BUCHHEIT. Yes. We will actually be transferring it to a farmer west of town. He will, in turn, set aside the five irrigation wells that he is presently using as a back-up municipal supply for the city of Guymon, and trade freshwater, essentially for sewage implement. But we will actually be reusing 1½ million gallons a day.

Senator NICKLES. So you will be using his well water, and he will be using your treated water for irrigation?

Miss BUCHHEIT. Yes, sir.

Senator NICKLES. That's an interesting concept. If you multiply that through, you'd be looking at a substantial amount.

Miss BUCHHEIT. But I understand EPA is really cutting back on their innovative alternative programs that really do encourage commonsense approaches to reuse of water.

Senator NICKLES. Well, I appreciate your suggestion.

STATEMENT OF BEN SAUNDERS, COLORADO GROUND WATER DISTRICTS

Mr. SAUNDERS. Senator Nickles, chairman, staff, I'm Ben Saunders. I am from northeast Colorado. I personally manage four ground water management districts. I am here on behalf of those four management districts. In addition, I am here on behalf of four surface water irrigators; three totally in Nebraska, and one partly in Nebraska and partly Colorado, and one natural resource district in Nebraska—the Upper Republic National Resource District.

We are all pleased to support this legislation. It seems kind of strange that here I work simply with ground water. And just recently about 6 months ago we won a Colorado Supreme Court decision against some surface water area. I think that what we have determined is we pretty near have to band together and work this problem out among ourselves and support any legislation if the Federal Government would help us.

I think we are all aware that surface water does raise out of the Ogallala aquifer. Commonsense tells us that as this aquifer goes down, that these springs decline in flow. As these springs decline in flow, of course, irrigation projects, which were built prior to development in the aquifer, they decline. And we are experiencing that in northeastern Colorado, slightly in southwest Nebraska.

I will present you some figures here shortly that we are experiencing pretty readily.

Now, we are from the area that Jack Weeks told you about, but we are further north. We haven't seen the drastic declines, but we don't want to. Just the slight declines or the marginal declines—as you might call it—in comparison to the 150-foot decline that we are talking about, if we see them, why, our surface water irrigation projects will go totally. So we are here asking and supporting some recharge to maintain what we, existing, have at the present time.

If you want the names of these irrigation districts, I would be more than glad to give them to you. I have met with all of them. We have agreed that I come down here, and they wish that they could have come and testified, but collectively we're saving our money for recharge projects instead of traveling around—

Senator NICKLES. You might get more money out of that.

Mr. SAUNDERS [continuing]. Traveling around to the Panhandle of Oklahoma, although it's very nice down here. And if you were to go through the eastern portion of Colorado, at least yesterday, you would wonder why we need recharge. There was snow laying all over, and water standing out on the wheat fields and everything else, and ice on

the highways. As soon as I get to Kansas, that stops and the roads were dry. So I guess that we're at the upper end of it. We are just trying to keep our water up there.

But I would like to present to the committee another map from the USGS, which depicts Colorado's water table decline, predevelopment up to 1980 and from 1975 to 1980, which you could look at your leisure. I do not want to go through it, although we do have some declines. But basically, looking in south of us down into the Burlington area we have experienced some radical declines. And they were 10 years ahead of us up north in development. And we don't want to see that happen up north.

They simply run out of water. When you run out of water it's pretty desolate—pretty desolate.

Senator NICKLES. You have some running out of water?

Mr. SAUNDERS. Excuse me, sir?

Senator NICKLES. Did you say that you had some running out of water?

Mr. SAUNDERS. There are places down in the Burlington area—I would not say are out of water—but they are not pumping near the water that they did when they started. In the districts that I manage, yes, we have had one well this last year to completely dry up. It was in the area of the Ogallala aquifer. It was the first one that I know of. It scares me to see it happen.

We do have a lot of wells that have lost their production. So they are raising wheat, using that well as an insurance policy for raising wheat or lesser water used crops.

OK. In Colorado we have, as a result of the \$6 million study, we went to conservation practices. The soil conservation districts have acquired the equipment for efficiency checks. Each and every well owner is given free and efficiency examination by the soil conservation districts if they want. They can clean up their acts—so to speak. A lot of them are going to the low pressure efforts, and of course, most of them know of the PIK program. A lot of them went through that this last year. We do cooperate with the USGS, and I just finished about a week ago measuring the water tables in the northern portion of the Ogallala in Colorado. Even though the high prices of pumping, the low prices of crops and the PIK program, the water table still went down.

So I see no alternative, except bringing water in to recharge this aquifer. We have done several studies; the Frenchman ecological area, which is watershed management program, whereby we built dams and pits and terraces. We had Colorado State University evaluate the recharge. We had to wait 3 years to get a rainfall to evaluate the recharge, but it did recharge in that small scale. But 17 inches of rainfall average a year—which 10 of it comes through during the growing season—we don't have many events to where we can evaluate recharge.

Another document that I would like to present to the committee is a document which was made up several years ago, which shows the impact of irrigation on different counties. Now, these are counties in Colorado, and of which some counties do have irrigation and other counties do not. And it gives you the irrigation wells per county, the property tax differentials, the local per capita tax differentials, the assessed evaluation, and the retail sales measurement of the growth.

Now, to me and to anybody that's concerned about irrigation development, this, to me, really spells it out. It was done by myself and a couple of irrigation specialists and Colorado State University agents.

Now, I would like to move on over into Nebraska and talk to you a little bit about the water table declines just across in Nebraska, the southwest portions of Nebraska, which encompasses the Upper Republican and Natural Resource District of which Ron Milner is the manager of and would like to be here today.

I would like to hand in or represent—this is the ground water levels in Nebraska in 1982. First of all, I would like to show you the red on page 37 indicate declines. The blues indicate rises. The rises are in excess of 60 foot. The declines are in excess of 60 foot. It looks to me like recharge can take place if we want to do it. And there is text with that, which I would not go into.

Now, I'm going to give you some information concerning some of our surface water—or some of the surface water projects. The underground water built on the Frenchman Creek inside Nebraska. There are two irrigation districts that use water out of it. In the 1950's and 1960's the inflow of that reservoir from the Frenchman Creek, which is fed from the Ogallala aquifer, was around 60,000 acre-feet of water. In 1982 and 1983 it is 22,000 to 23,000 acre-feet of water. Those people irrigating under that are having to use or get by with 7 to 8 inches of water per acre to grow their crops. We use approximately 18 inches of water per acre to raise the corn crop. So that has been cut drastically. These two irrigation districts irrigate 11,700 acres and 9,600 irrigated acres respectively. That's not much water.

We do have a project, which we have talked to the Bureau of Reclamation about. We have asked them for funding to help us with a feasibility study. It is a plan to take water out of the South Platte River, which runs through northeastern Colorado. During floodflows, bring water into the northeast Colorado portion of the Ogallala aquifer. Use it for storage and surface water irrigation to maintain the Ogallala aquifer and hopefully raise water tables to bring the Frenchman Creek to flowing again, so that the other reservoirs could have some water again, so these irrigated acres can be again watered with some suitable amounts of water.

As to the conservation practice of these surface water people, which I can't speak very much in depth, but in the year of 1981 and 1982 irrigation season they physically pumped back from below the reservoir, which was seepage, over 3,000 acre-feet back into the reservoir so that they could have it to use for irrigation water.

Now, this isn't conservation practice to me. Instead of letting it seep on down, maybe it would have recharged the aquifer. I'm not sure. But there are some of them folks that do use ground water to supplement their surface water.

As a closing statement, the Bureau of Reclamation did study this Republican Frenchman Unit back in 1978. One of their concluding comments was that there is evidence the water shortages within this Frenchman Unit are going to become progressively worse. Therefore, the water users should take every possible step to conserve the available water supply. That just told them that there was no hope for them. In my book they are through.

Again, Senator, and committee members, and staff, thank you very much for the opportunity to appear.

Senator NICKLES. Thank you, Mr. Saunders. I appreciate your input and also the fact that you bring into this hearing the fact that we're not looking at just an Oklahoma problem. We are looking at several States that are wrestling with a similar problem. In many cases it varies from county to county, but, yes, we do have a multi-State problem. It's one that we can work together on with some Federal assistance to tie it together and come up with a few demonstration projects different perhaps in eastern Colorado or in Nebraska or maybe a little bit different techniques than what we might try in the Panhandle of Oklahoma or Texas. But we appreciate your coming from so far and giving us the benefit of your thoughts in this area.

Our next guest we have Mr. Frank Moore, Oklahoma Farm Bureau.

STATEMENT OF FRANK MOORE, OKLAHOMA FARM BUREAU

Mr. MOORE. Thank you, Senator. It's a pleasure for me to get back out here. This is home for me. I was raised up north of Buffalo and had a ranching operation over here in the eastern part of Woodward County for about 25 years. It's good to be back.

Senator NICKLES. Good.

Mr. MOORE. At the present time I reside in Edmond, and I work for the Oklahoma Farm Bureau. I have a statewide responsibility in the area of governmental affects. And I want to speak from that angle, at least for a little bit.

It's basic law in the State of Oklahoma that ground water belongs to the surface owner. And if we proceed with these kind of projects, I have what I call flags that I raise, and we want to keep that basic right, right for our needs. Now, in a case of surface water, the water belongs to the surface owner as long as it's contained where it fell. Once it flows off of the farm into a stream, then, it is appropriated by the State.

Now, we have some basic law in Oklahoma in dealing with the transfer of water from one region to another. And it was deliberately written into the law that the area of origin must have enough water to take care of its needs before any water is transferred out. That is a basic piece of the law. Now, another factor is that if you need—I think the United States—in Oklahoma we have enough water, I'm told, flowing past one point down in southeastern Oklahoma to provide the total needs of this State for the next 50 or 100 years. It flows by there every day. It doesn't have to be impounded. It is just flowing by there. And we've taken steps in the last few years to maintain the control of the appropriation of that water, but that's temporary. Somebody is going to use that water. Texas would love to have it. They've got some schemes similar to what we are talking about here in terms of going all the way out in the Amarillo area for some of that water. Somebody is going to use that water.

And we've tried in Oklahoma to provide the basic law that would allow us to use it in Oklahoma if we determine to do that.

Now, there is one thing about this recharge, and that is once we determine—should we determine—that it's feasible, then, we still have

to find the water supply. We've got to get that water supply to that area. And we already have the technology to move the water. It has not been determined that it is economically feasible to go as far as the panhandle, but it possibly is economically feasible to go into what they call central Oklahoma area and maybe even southwestern Oklahoma. With that water that comes out of southeastern Oklahoma—and that is beautiful water. It is potable. It doesn't have to be cleaned up. It's good water.

So we have a water supply if we want to use it. Now, farm bureau supports research for determining whether we can recharge these areas. I'm not going to take position on the bills. Somebody else has the authority to do that. But I am going to raise the flag about how we apply the resources we have that we perceive. And I think we do need to do some research in the area of recharge, but we don't want to forget about these other areas that have already been talked about to some extent.

Senator NICKLES. Good point.

Mr. MOORE. And I think we want to remember that probably we don't have all of the technology developed that needs to be developed in terms of using water efficiently. We've got some drip systems and things like that that use water very efficiently. And we need to be sure that we apply some of our resources to continue that research.

Now, in addition to that we already have technology and have known about technology that could double the amount of cattle that could be produced in Woodward County dryland. And we have had that technology in those management practices developed for over 20 years. Some people, I'm sure, are using those practices, but not nearly as many as there should. So we need to put all of that packaged together, I think, as we proceed along and try to get as much out of our dollar as we can.

Now, there's another area that concerns me that I'm going to raise here. Across my desk last summer came a study that was done as a result of some Federal money that was spread into the State; that would develop regulations for agriculture that is over the existing water aquifers that we know—like the Ogallala and the Wellington and the other smaller ones. In the original graph that I was looking at that day said that you would not have the concentration of cattle over any known aquifer. That meant that you would have to move all of your dairies off of that aquifer. You couldn't have a corral on a farmstead where you had cattle together to work them. There would be a limit on how many cattle should be put on wheat pastures. There would be a limit on how much fertilizer could be used over that aquifer, and at certain times they wouldn't allow you to put any fertilizer on it.

Senator NICKLES. Make sure everybody knows that that wasn't mine. That it's not this legislature—

Mr. MOORE. This was a study that was done in Oklahoma but it is relative because we're talking about ground water and protecting the quality of ground water.

Now, after I came down off of the ceiling, I talked to quote a few folks about this and wrote a letter outlining what would happen to that agriculture if we followed those kind of regulations. And it's

those kind of things, coupled with what's going to happen to the ownership of water as we deplete Federal dollars into this situation. And I think we need to watch very closely.

Oklahoma is a wonderful State. We have done well for ourselves, and I think we are way ahead of the Nation in a lot of ways. There's people—the last year or two—have been quite excited about the [inaudible] operations and the minimum scales and that sort of thing. But Senator, we've been doing that in Oklahoma since the 1930's.

I was right up here north of Buffalo in the 1930's and we had what we called dammers that we pulled behind listers that made a little dam every 6 feet and collected the water so it wouldn't run off. We had some outfits that we called puddlers that we dug over the wheat land that dug out holes every so often and collected the water so it wouldn't fall off. Then came a development called the chisel plow and the Noble sweep and the large sweep and the Graham-Hoeme and the Kraft's chisel and the high-center chisel that have enhanced our opportunity to utilize the moisture that falls out here and to prove it. And today there are farmers out here that I recognize that don't know what it is to suffer a loss of wheat crop due to drought because of that technology. And the horsepower that we've got and the early varieties of wheat and all have that. We are very efficient out here in the way we produce in Oklahoma. And I think that's to our credit. Not to say that we have reached a peak by any means, but I think we need to be very alert and very careful as we proceed.

I want to thank you, Senator, for having these kind of hearings and taking an interest in this kind of legislation. And we want to support you, and I hope you will proceed.

Senator NICKLES. Thank you, Mr. Moore. We appreciate your support and also appreciate the comments that the Farm Bureau has given on this and other legislation. You have been very helpful to me. Again, I want to make sure that everyone knows that that wasn't my legislation. Was that Federal or State?

Mr. MOORE. Well, it was a Federal grant that came down here—

Senator NICKLES. It was proposed, but it wasn't introduced in the legislation?

Mr. MOORE. No, no. I'm not talking about the legislation. It proposed a regulation that would be operated by the pollution coordinating control board.

Senator NICKLES. Well, keep us advised when you see stuff like that going anywhere. I don't believe that it will, but anyway, we need to know about those things.

Just one question, mayor. I'm looking at Guymon and looking at this sheet that was just given to us as far as the amount of depletion. Guymon happens to be sitting on the area that has some of the biggest decrease. I think you mentioned in your statement that you had something like 100 foot decline or 50 foot decline?

Mr. BRALEY. Right. Just south of town.

Senator NICKLES. Just south of town?

Mr. BRALEY. Right.

Senator NICKLES. It shows up on this map as a pretty significant area of 50 feet or more.

I think you also directed a few comments that because of the high cost of gas, you have seen a little less irrigation.

Mr. BRALEY. There has been a definite cut-back——

Senator NICKLES. In Texas County?

Mr. BRALEY [continuing]. And much concern about it.

Senator NICKLES. Does that hurt the economy quite a bit?

Mr. BRALEY. Yes, it sure does.

Senator NICKLES. Your farmers, can they produce very much without irrigation?

Mr. BRALEY. No, sir; not relative to what they have produced with irrigation. And of course, the old saying is that we have a crop every 6 or 7 years that we can dryland farm in the Oklahoma panhandle. That's not true.

Senator NICKLES. Some have mentioned, and Mr. Moore talked about the 1930's, that a lot of improvements have been made. We did take somewhat of the brunt of the drought during the Depression when we saw a lot of farms blown away. Some people say that if we're not careful and don't do a better job with conservation, we will see a reenactment of that. Do any of you care to comment on that?

Mr. BRALEY. I think that would be 100 percent true if we absolutely run completely out of water, and then, we are unable to use it in agriculture at all. In essence, that's what happened before. And of course, poor methods of farming and land management, those have all changed. Without water I'm sure you would see some of it. There are areas out there where this aquifer doesn't have any—it isn't available, and you can see that occasionally through a 3 or 4 year period where they have moved up the land.

Senator NICKLES. I have driven and flown in western Oklahoma and in the panhandle areas and southwestern Kansas at different times when the wind was blowing, and you were driving right through topsoil.

Mr. BRALEY. That's right.

Senator NICKLES. Again, too many people think that those are things that always happen in times past. I think conservation—a lot of things have been done where we wouldn't possibly see a reenactment of the 1930's. But, again, we still have a lot of serious problems that I don't know that people are aware of that are happening today. We have even seen airports close because the wind was blowing topsoil to an extent that you couldn't really see.

Mr. BRALEY. Yes, sir.

Senator NICKLES. Any comment on that, Mr. Moore?

Mr. MOORE. This is the danger, we don't have a situation like we had in the 1930's. For one thing, in the 1930's we didn't have the means to control the wind erosion. And in a lot of cases the land was just abandoned and left to nature. Today we do have those means, and in almost all cases a farmer will take the step to control that wind erosion. That's not saying that we won't have some duststorms, but I would not expect them to be that severe as they were in the 1930's.

Senator NICKLES. Gentlemen, I appreciate your comments. You have contributed to this hearing, and I appreciate having input from those who are directly affected and whose income and livelihood and the future of their community would be affected by the declining water

tables. In the future maybe some changes can be made. So thanks a bunch for appearing before the committee.

Mr. BRALEY. Thank you very much.

Senator NICKLES. For our next panel we have Bonita Hoeme, Ralph Compton, and Claude Frazee.

Mr. HIGGINS. May I join this panel? My name wasn't on the list, but I thought it was.

Senator NICKLES. Oh, please do.

STATEMENT OF VIRGIL HIGGINS, PANHANDLE WELL HEAD GAS USERS ASSOCIATION

Senator NICKLES. All right. We are ready to go now.

Mr. HIGGINS. Thank you, Senator.

Senator NICKLES. You need to put the microphone right up in front of you. We have some people that can't hear way in the back.

Mr. HIGGINS. It is certainly an advantage of being near the end of the program because a lot of what I was going to say has already been covered—and I might say—much better than what I would have done myself. I especially would like to agree with Mr. Barby's comments concerning the use of freshwater—

Senator NICKLES. For the record, could you identify yourself and where you are from?

Mr. HIGGINS. Yes. I'm Virgil Higgins representing the Panhandle Well Head Gas Users Association. We thought we were on the program, but there was a little bit—we are very specialized in the panhandle. We have Mr. Compton, who is representing the Panhandle Gas Users Association, and we are the Panhandle Well Head Gas Users Association. So as I said, we are very specialized. We thought we were on the program.

Senator NICKLES. Well, I apologize.

Mr. HIGGINS. I think that's probably the reason.

Senator NICKLES. Well, you're on it now so—

Mr. HIGGINS. I would like to second Mr. Barby's comments concerning the use of freshwater for secondary recovery and Mr. Lucas and Mr. Braley and Frank Moore. As I said, I represent the Panhandle Well Head Gas Users Association. The president, Johnnie Brines, was unable to attend today, and he asked me to make a statement.

We organized about 3 years ago and served primarily as an advocate for irrigation farming using wellhead gas in combating unfavorable rate increases in the cost of natural gas. This was our primary and sole purpose in organizing, and we have been successful in maintaining a status quo up to this point.

We realize, however, that we may win some battles, but we cannot win the war. The cost of gas will go up. Since the beginning of irrigation in the panhandle, we have had the advantage of low cost fuel to power our irrigation. Many hundreds of thousands of acres have been developed at enormous costs with the understanding that the cost of fuel would not be a problem. We now face increases of as much as 800 percent in the cost of fuel.

I would have to agree that the gas for my particular wells is probably worth more than I'm paying at the present time, but I can't absorb that kind of an increase.

Senator NICKLES. What are you paying?

Mr. HIGGINS. 56 cents.

Senator NICKLES. I will take some of that \$0.56, and you can go ahead.

Mr. HIGGINS. I hoped that you wouldn't ask that question.

For example, though, the cost of my fuel—and I would consider myself a relatively small farmer—runs approximately \$8,000 a year, now, at \$0.56 a thousand. If this increases by 800 percent, which we are being threatened with that and have been posing that for 3 years, that bill would go from \$8,000 a year to \$64,000 a year. And this is the cost which, as you know, cannot be passed on to the consumer, the farmer.

I would also agree that the price of fuel is not the problem. The problem is the price we receive for the commodities that we raise. But not being able to do anything about that at this time, we must do what we can to maintain a reasonably priced fuel in order to stay in business.

Another potential problem looming on the horizon is the recent Texaco-Getty merger. Texaco will not even sell us gas. We don't know this, but we are hearing rumors of this.

I realize my statement so far seems to have little to do with the purposes of this hearing today. However, if we cannot be assured reasonably priced fuel for our irrigations, with the price of our commodities at current levels, we don't need to recharge the Ogallala, and we don't need to transport water from eastern Oklahoma, because we can't afford to pump it. This is from an agricultural standpoint. If we are forced out of irrigation, the economic, social, and human impact would be severe.

At this time I would like to make a few comments—personal comments—as to irrigation framers from Guymon. For several years I have felt that we, perhaps, were misusing valuable resources by continuing to irrigate field crops, such as wheat, corn, and milo, crops which many times are in oversupply. We, then, sell our product on a flooded market, often below the cost of production. Overall, however, irrigation has been very good for the panhandle and for the State of Oklahoma. It's improved the quality of life for many people for many years. We've fed a lot of cattle and a lot of people all over the world.

There have been studies made on the Ogallala for years that have only told us what we already know. I have a little pet project that I've been thinking about for a number of years. Why don't we consider spending some of the money on research at agricultural experiment stations throughout the Ogallala system? We should be looking for alternate high-dollar crops and investigating drip and tricular irrigation systems. We've got the water right now. It's just 300 feet right straight down. We've got the distribution systems. We've got the wells, and we've got the underground pipe. What we need is a more efficient and better way to use what we have.

Recharge of the Ogallala is definitely something we should consider. The High Plains Research Foundation in Plainview, Tex., have been working on this since 1969. I have an old report here with some of the results, which I will make available to the committee if they are interested.

We appreciate your interest, Senator Nickles and members of the committee, in this problem which is of great concern of ours. And

we also appreciate you holding this meeting out in our part of the country.

That concludes—except I have one problem. I may need to catch a ride back to Guymon with someone because I drove here this morning with Paul Hedge, who is a member of the Hedge family, which is a large volume cattle feeder in our area. He may take exception to my suggestion that we replace corn with some other crop. The feed-lots have been very good to us, though, and very important to the agricultural economy in the panhandle.

Senator NICKLES. Thank you for your comments. I appreciate it. We have one more panel. So we are going to have to make sure we get everybody in.

STATEMENT OF RALPH COMPTON, CIMARRON COUNTY IRRIGATION USERS, PANHANDLE GAS USERS ASSOCIATION

Mr. COMPTON. Senator, my name is Ralph Compton. I'm from Boise City. I am representing, in fact, several groups here today. The Cimarron County Irrigation Association and the Gas Users Association and the city of Boise City and also speaking—asked to convey regards from Mr. Julius Cox, who is a member of the high plains Ogallala study, who would appreciate very much the opportunity to be here.

I'm not going to bore you and the other members of the panel and the other speakers here with repetition. I will try to avoid that. I missed a good part of the hearing this morning. So I hear that most of the areas have been covered.

I do have some data on the decline of the water tables from which the city of Boise City is pumping their water, and I have this data here and will soon present it to you. And you all can study it at your leisure.

My own experience, we have nine irrigation wells on our farm, which is east of Boise City. We are pumping from the Ogallala. From about 400 feet of those nine wells, three of the wells are no longer—two of the wells are no longer being pumped. One of the wells is being pumped at a very slight rate. And the only reason we use it at all is because one of the nine wells—we are blessed with \$0.56 like Mr. Higgins, here.

So we won't get into the prices of gas because we all know that the prices of gas and public utility companies are very high up in the \$5 range.

I have been very impressed with the study that the high plains committee turned in on the Ogallala, and I'm sure you can leave with that. Any action in which you all have taken should be consulted. It was very comprehensive. These people know what is good, and they are no longer talking about it.

Again, a lot of these things are repetitious. We know what our problem is. We all know what the problem is if we pump this thing, we are going to lose it.

The city of Boise City has abandoned three wells up there. We've got a declining water table. Another thing that is common over the Ogallala—and we don't have all of the surface supplies of water. We don't have them that we can go to. We realize that the panhandle—especially in the West and in the panhandle—that it is not economi-

cally feasible at this time and it may not be for 25 or 50 years to import water from the eastern part of Oklahoma.

There has been quite a bit of work done on water importation studies on other parts of the world where there are tremendous quantities of water available. This thing needs to be looked into. There's a lot of engineering and political bridges that are going to have to be crossed and cleared up so you, gentlemen, do indeed have a problem.

I would like to respond to one of the distinguished speakers earlier that said in effect that there's no way we're going to be returning what we saw in the 1930's due to the technology and equipment that we have available to us. Probably, we wouldn't return as quick, but I can solemnly assure you, and you can take the biggest tractor or the biggest plows, and if you get your topsoil in condition, and you can go out there and work it, and you can hold that soil from wind erosion as long as you have moisture in which to work with. If you do not have the moisture either from natural rainfall or snowfall or irrigation in which to do it, about the only thing that's going to happen is you take the \$200,000 tractor and put it with the plow and go out there and work on your sandy soil. If you work from 6 inches deep, that's just the depth that will be destroyed by wind erosion. I'm speaking of this as an observer of the sandy soils that we have in Western counties.

We are well aware of the problems that are facing you and the people with the bill. We would like to urge you, again as Mr. Higgins did, that there is a great deal of research that needs to be carried on with the drip irrigation. We still have our resources. We haven't lost it. And there need to be viable alternatives, say, to flood irrigation. There will be some people to grit their teeth when they hear me say this because they say, "I don't want to go out here and do this, that, or the other."

Those of us in the water-short areas have by the very necessary conservation practices that we hadn't heard about and hadn't found a way to conserve our water. We started out originally doing this with tail-water recovery systems. We went from there to abandoning our flood-type systems and went to the sprinkler-type irrigation systems. That has given as much as 60-percent increase in the acres of crops that we can irrigate using the same amount of energy and water. These things all need to be looked into by the committee.

I want to congratulate you people on having the energy to undertake the task at your side because it is indeed a very excitable and a mind-boggling undertaking. We realize, also, that there will be no immediate, quick, easy answers. And with that, I have no further comments.

Senator NICKLES. Thank you, Mr. Compton. You are right. You are certainly right about quick and easy answers. And I appreciate you coming. And your home is in Boise City?

Mr. COMPTON. Yes, sir.

Senator NICKLES. I appreciate that you came from a very good distance, and I further appreciate you coming over.

STATEMENT OF WORTH JEFFUS, GUYMON, OKLA.

Mr. JEFFUS. Thank you, Senator Nickles, for allowing me to come to the staff. I'm Worth Jeffus from Guymon, Okla. I am a farmer and rancher near Guymon. I'm also a member of the Governor's advisory

task force in the high plains study group. And I've been a member of the soil conservation district for over 22 years in Texas County. And I have a little statement that I would like to read, a personal statement and a personal view as to what this pertains to.

For over 60 years I have lived on the high plains. During this 60 years span I have experienced the good and the bad. I have seen the results of dryland farming along with the duststorm in the 1930's and have shared the benefits of both dryland and irrigated farming. Of these things I have firsthand knowledge and can testify to the results.

Since 1947 we have been engaged in farming and ranching in Texas County, Okla. Our farming was entirely dryland until 1956 at which time the first irrigation well was drilled. The primary cost in dryland conditions was wheat. The secondary was milo in the years that weather conditions permitted.

The average year for wheat is from 10 to 12 bushels per acre. Some years the production would be up to 30 bushels, with many years yielding 9 to 5 or 7 bushels. Wheat pastures for cattle would be a probability of about 2 out of 5 years. Milo and grants are dependable about 1 out of every 5 years. With some sort of forage crops for cattle, 3 or 5, providing some winter feed for the limited number of livestock.

The story is different under irrigation conditions. With water from the Ogallala aquifer and a reasonable and reliable source of fuel to produce the needed water, this has stabilized the agriculture in Texas County and the high plains and provided a balanced source of grain and forage to sustain a multimillion dollar cattle business in the area.

Irrigation is also responsible for the highest per capital income in the State as realized by the people in the area of the Oklahoma Panhandle. It is unfortunate that most farmers don't share this high income due to the cost of production coupled with low prices for their products. As results the net return on their investment is a very small percentage as compared to other industries.

Irrigation has allowed us to grow corn which cannot be done under dryland conditions. The yields vary from 100 to 200 bushels per acre. Initially it runs from 15 to 25 tons per acre. These yields are obtained year after year. Milo is an excellent cash crop that will produce up to 150 bushels per acre. The next best crop under irrigation is wheat. It returns 50 to 60 bushels and provides a great deal of winter pasture for our growing cattle.

I would like to think of a newly harvested crop as gold from the ground. This new crop has never been sold before. It is the same as new money from the soil. This new money goes for services and goods from all over the country. It effects the entire Nation. As farmers prosper, so does the Nation. Each harvest puts a ripple into the Nation's economy. With adequate water and fuel at a reasonable cost, the Oklahoma Panhandle could triple its production in times of need. Without water, agriculture and the related economy will decline down to a level of the 1930's and 1940's, and a disaster will strike Guymon and Texas County. It would be possible for the entire area to return to a severe duststorm, even worse than in the 1930's. Should ground cover be lost and without adequate moisture in the soil due to a prolonged drought, all of the modern machinery could not prevent this from happening should the weather conditions so dictate.

Finally, with the decline of the Ogallala aquifer and the irrigation, so goes the domestic water. The shallow windmill wells made it possible for early settlers to survive and to make this such a good agricultural area. There is enough freshwater that goes out of the mouth of the Mississippi every day lost in the saltwater of the gulf to supply the domestic irrigation and industrial needs.

I would urge the ground water research demonstration bill and that a plan for importing water to the high plains be implemented as soon as possible. It is recommended that a study be made thoroughly in investigating the possibilities of recharge in the Ogallala aquifer that this would be the best story for any imported water or natural runoff from rain or snow.

Senator NICKLES. Thank you very much. I appreciate your comments.

STATEMENT OF CLAUDE FRAZEE, ELMWOOD, OKLA.

Mr. FRAZEE. My name is Claude Frazee. I'm a farmer, rancher, irrigator from south of Beaver. We are glad to have this opportunity to come before you to give you some information on what is going on out in Beaver. I have had trouble with the oil companies polluting our underground water. And where we first sent in our test, we was trying to get the State and the health department to test our water, and they didn't seem to be doing any good. We took a sample of water to the Shattuck Hospital. And Dr. Haskell Newman sent in—we took a gallon of water, and he sent—split it. He sent half of it to the health department and half of it to the medical arts lab. And when the test came back, the health department, there was nothing wrong with the water. The medical arts lab, there was 6.9 lead. They had "condemned, not acceptable" written on the sheet. And it went before the corporation commission and the health department and the pollution boys and didn't get anything done. It's too late to do anything out there now, but if we don't keep this pollution of our fresh Ogallala water protected now, well, we will have nothing but desert. And he said why didn't we go to the EPA. I called the EPA in Washington, D.C. They referred us to Dallas. Dallas sent Charles Sievers up after I finally got the State to invite the EPA in. They said that they would come in and help find the leak and help seal it off if they could get invited in.

I got them invited in. They came in, tested the water, and Charles Sievers was ramrodding the project. He wrote me a letter that said, "Your water is polluted. I'm looking forward to seeing you in Oklahoma City."

I went down there, and he said that there was nothing wrong with our water. To move over 10 feet and drill another hole and gravel pack it, and that was all that was necessary.

Senator NICKLES. Did you do that?

Mr. FRAZEE. The new hole?

Senator NICKLES. Yes.

Mr. FRAZEE. No, I didn't. I didn't have the money. You can't seal it out with gravel. You can't seal out lead. The only way that you can get that out is distilling it. We have had to distill that. We distilled the water. At times it would come in, we'll have to haul water from about a half a mile off to get water that we can drink.

Senator NICKLES. Was the water contaminated to the extent that you—this was for your drinking water for your farm?

Mr. FRAZEE. This was for the house water and for the stock.

Senator NICKLES. Was it contaminated too much for irrigation or other purposes?

Mr. FRAZEE. Well, the salt never had rose up to where it killed the land, yet. But what happened, they drilled a well south and west of us. The intent sheet showed that they would put in 1,200 feet of surface casing. They never set a foot of casing. They went down to 4,800 and some feet, twisted off, and set their pressure up for about 3 weeks. And then, they run a little cement on top of the hole. We don't know what's bubbling up down below.

In 3 weeks time we were pumping water in a 17-foot tank for the stock. And in 3 weeks time that was about 4 inches deep with just plain old drilling pipe in the bottom of the tank. You could run it in the bathtub and it would look like sand on the bottom. You could be taking a bath and the soap would raise to the top—just scum on top.

I've got a sheet here—a booklet—that I presented before the corporation commission down there. I also have that test on that water and everything. It's in there.

Senator NICKLES. All right. You can keep that. That won't have too much to do with this hearing.

I'm going to have to—I've got two more people that I promised I would let testify. And I've only got about 10 minutes. So I need to bring them up as well.

So I appreciate your statement and hope that you get some cooperation. We are going to have someone from the water resources board in just a minute, and maybe they will help you a little bit. And I appreciate, also, the fact that—I hope you get back to Guymon.

STATEMENT OF RICK JAMESON, EXECUTIVE DIRECTOR, OKLAHOMA WILDLIFE FEDERATION

Mr. JAMESON. Thank you, Senator. There is no apology for having me wait until the end. I learned a great deal. I hope my comments are better than what they would have been when I first walked in.

My name is Rick Jameson. I am executive director of the Oklahoma Wildlife Federation. It is a statewide private, nonprofit association of 10,000 individuals, 41 affiliated clubs in Oklahoma. We appreciate the opportunity to speak on the critical board of resource issue addressed in Senate bill 1811. Your work on the very important Senate Subcommittee on Water and Power is appreciated and your competence approach to Federal involvement in water projects is very refreshing. I appreciate the work that you are doing.

The Oklahoma Wildlife Federation and National Wildlife Federation endorsed the concept of Senate bill 1811 because of its innovative approach. We like the fact that you are approaching this problem on a multi-State area where there are documented problems and not going the traditional route of just looking for a slice of the pie for Oklahoma. We like the systematic study of the problem that is incorporated in the bill. We like the cautionary requirements that it should always be a part of any Federal project.

This bill seems to allow for more benign method of addressing water development and water usage. We are pleased to see that. Certainly, this is a less destructive and much less costly approach than the large-scale irrigation and reservoir building that has been the traditional method that Congress has used to address water problems.

We have seen several indicators and more statements of society, and Congress, in particular, is recognizing that our water resources and our financial resources are finite, and that we must live within our given budgets. We must not mortgage our children's future by spending these resources faster than they can be replaced.

I'm sure that everyone has a different perception of what this bill might do. I'm not sure exactly how this is going to end up. Maybe you are not either, but it obviously means different things for different people. It's obvious, however, that improved agriculture techniques, as the professor from OSU cited, domestic water conservation as the former Woodward City manager suggested, preventing the use of freshwater and tertiary oil recovery and protecting quality of our ground water. As Save Our Water proposed, land application for municipal wastewater as Woodward practices and Guymon is heading toward. And other practical and innovative techniques either used separately or in combination can be very effective in cost and efficiency.

I would just say that the only technique that we have heard this morning that we could not support would be the draining of the playa lakes. Because these lakes are heavily used and a critical wildlife habitat. I also believe that that would be contrary to the existing Federal policy, which says that we ought to save and protect our wetland resources. But I think that the approach of putting our heads together, using the commonsense of local residents and the best minds of our universities will most probably be more productive and certainly more feasible than throwing millions and billions of dollars into reservoirs and canals.

The approach in this bill looks from multiple solutions, not the Great Lakes or the Missouri River or even eastern Oklahoma. Senator, we think you are on the right track, and we support your efforts. Thank you.

Senator NICKLES. Thank you, Mr. Jameson. I appreciate your comments.

Mr. Bryant.

STATEMENT OF JIM BRYANT, WATER RESOURCE PLANNER, PLANNING AND DEVELOPMENT DIVISION, OKLAHOMA WATER RESOURCES BOARD

Mr. BRYANT. Yes. Good afternoon, Senator. My name is Jim Bryant. I'm a water resources planner for the planning and development division of the Oklahoma Water Resources Board. I appreciate you fitting me in here late in your schedule. Rick Smith was originally going to be here this morning for the first panel, but he could not attend.

I have worked with the high plains study for several years here now, and we have just recently released the Oklahoma research results for the total six-State study which was actually released about a year and a half ago, I guess. We are very much in favor on ground water management and also supporting of the legislation here. I'm

just going to read a short statement in support of your Senate bill 1811.

The Oklahoma Water Resources Board, the water resources agency for the State of Oklahoma is pleased to testify today in support of Senate bill 1811, the High Plains States Groundwater Demonstration Program Act. We view passage of this legislation as a vital first step if at first the adverse consequences of ground water depletion in the United States and your particular Ogallala aquifer area are to be litigated. Furthermore, both the purpose and the intent of the act are consistent with Oklahoma Comprehensive Water Plans. Recognition of the need to investigate and promote new technologies and practices which aid in automatic ground water supplies. It should be pointed out that the Oklahoma Comprehensive Water Plan, which the board prepared, has been officially adopted by the legislature as the guidance document for Oklahoma's future of water development.

Ground water recharge is such that is not new to Oklahoma. We have been engaged in a very successful project in southwest Oklahoma to recharge the Blaine Gypsum and Dog Creek Shale for many years. This Harmon County recharge program has provided thousands of acre-feet of additional water for irrigation purposes. We believe that success of this program thoroughly demonstrates the necessity for future work in ground water recharge.

Intensive irrigation farming and livestock operations in western Oklahoma and other High Plains States have placed heavy demands on existing ground water supplies and accentuate the need to plan for future supplies sources. Although recharge programs should not be perceived as a panacea to solve all of our water problems. The physical and economic merits of such projects are clearly deserving and a thorough assessment as envisioned by your Senate bill 1811.

In conclusion, the board appreciates the opportunity to appear at this field hearing and applauds your efforts to solicit public comment on this important piece of legislation and urges Congress to pass Senate bill 1811 as soon as possible.

Senator, I might also add that the water resources board has used some of the funds out of the statewide water development revolving fund to fund some ground water recharge studies with direct contract with Dr. Wayne Pettyjohn of Oklahoma State University which should provide, possibly, some valuable information about the possibility of implementing this sort of strategy. And if there are any further questions for the board, I would be happy to stay after the hearing and answer those.

Senator NICKLES. I think, Mr. Bryant, that there probably was. As I'm sure you heard, there was one of our panelists that was having a problem that he would like to visit with you about. And possibly, if you could help him, it sounds like he's been going through the red-tape in trying to get some assistance. If you could help him, I would appreciate it. I'm sure that he would, too.

One quick question. You heard a couple of previous panels mention the fact of using good fresh water as far as for injection wells. Does the board have a policy for that or against it? Has it been allowed or endorsed by the board?

Mr. BRYANT. I believe Mr. Barby testified earlier. Yes, he was correct in his assessment. The board has approved use of freshwater for ground—or for secondary and tertiary oil recovery in the past. The

board is still studying this situation. I don't really have a comment about what the future position is going to be.

Senator NICKLES. Could you provide this committee how much of that is going on in Oklahoma. I think he mentioned—do you have that information available?

Mr. BRYANT. I, myself, don't have an accurate figure.

Senator NICKLES. I knew that you wouldn't, right now. I was meaning for the record.

Mr. BRYANT. It could be provided certainly. Our ground water division with the water resources board, you know has worked toward, you know, they are in charge of basically approving or denying permits.

Senator NICKLES. Do they have to get a permit to use for the freshwater?

Mr. BRYANT. Yes. All beneficial uses of water have to be approved by the State, and which the Oklahoma Water Resources Board is in charge of them.

Senator NICKLES. I would be interested in knowing how widespread that is. How much water is involved. It's kind of hard to tell today how much water is involved, and certainly, if in most of those applications if saltwater would work, that seems to be preferable, particularly in these areas where we are looking at water shortages; the cost of water going up every day.

So if you would provide that information to me and to this committee, it would be very much appreciated.

Mr. BRYANT. Certainly.

Senator NICKLES. Gentlemen, I appreciate your statements. You, and several other people mentioned that this bill is not a panacea. It's not a panacea, but I think it is a step in the right direction. And I think it will help, but it will not solve all of the problems. There were a lot of good suggestions today by a lot of people dealing with conservation and other techniques. I think it's going to take a combination of a lot of those efforts for us to be successful and for western Oklahoma and really the States and counties that are underlain by the high plains aquifer to have a good long-range future. I think it's going to take a combination of a lot of these steps to be made, so that we will have ample water for the future.

So, again. I appreciate your attendance. Many of you, again, I know came from a long ways, and I'm very appreciative of that. I am appreciative of the fact that we had a lot of people that this is very close to their home and to their heart. It is an important issue, and that's the reason why we had it out here instead of just in Oklahoma City or in Washington, D.C. So we appreciate your input. We did ask people to sign up. If you did sign up, we'll try and stay in touch with you as we develop the legislation. If you are interested in a copy of the record of this hearing, we will send that to you as well. If you have additional comments, we will be keeping the record open for an additional 2 weeks. I also have a statement from a gentleman from Texas. We will enter that into the record as well.

We are out of time. I appreciate your patience and also your interest. This hearing is adjourned.

[Whereupon, the hearing was adjourned.]

APPENDIX

ADDITIONAL MATERIAL SUBMITTED FOR THE RECORD

RICHARD D. LAMM
Governor



JERIS A. DANIELSON
State Engineer

OFFICE OF THE STATE ENGINEER
DIVISION OF WATER RESOURCES

1313 Sherman Street-Room 818
Denver, Colorado 80203
(303) 866-3581

February 28, 1984

The Honorable Don Nickels
United States Senate
The Capitol, Room SH713
Washington, D.C. 20510

SUBJECT: Letter in Support of S. 1811

Dear Senator Nickels:

The Colorado Ground Water Commission is responsible for the administration of ground water in the Northern and Southern High Plains in eastern Colorado, which encompasses approximately 12,000 square miles. The major source of water for irrigation, municipal, domestic, livestock and other uses in the area is the Ogallala Aquifer. The water levels in the Ogallala Aquifer in Colorado are declining and the economic reality of this is currently being felt in many areas of the Colorado High Plains Region.

The Ground Water Commission recognizes the need to impound rainfall for recharge into the Ogallala Aquifer. Such practices will slow the decline of water levels and help sustain the agricultural economy in the area. The Commission also recognizes the need for demonstration recharge projects to determine the most cost effective locations for permanent recharge structures.

The Colorado Ground Water Commission strongly supports the initiative outlined in S. 1811, and hereby requests that this letter be incorporated into the record of the field hearing held February 17, 1984 concerning same. The Commission will be suggesting locations in the Northern and Southern High Plains that would be appropriate for demonstration recharge projects.

If we can be of any further assistance, please feel free to contact me.

Sincerely yours,

Jeris A. Danielson
Jeris A. Danielson
Executive Director
Colorado Ground Water Commission

JAD/MAS/mah

cc: Russell R. Brown, Professional Staff,
Subcommittee on Water and Power
Ground Water Commission Members

Testimony of

Dr. Jay H. Lehr
Executive Director
National Water Well Association

in support of

Senate Bill 1811
"High Plains States Groundwater Demonstration Program Act of 1983"

It is an honor and pleasure for me to accept the invitation of Senator Nickles to speak on behalf of his Senate Bill 1811 known as the "High Plains States Groundwater Demonstration Program Act of 1983." It is unfortunate and a strange coincidence that I was unable to offer my testimony in person on February 17 in Woodward, Oklahoma, due to a conflict from a prior request by Oklahoma Congressman Wes Watkins that I speak at a ground water conference in Washington on February 16. That precluded my timely travel to Woodward. I will try to make up in absentia with a broader scientifically supportable commentary more comprehensive than that which would have been allowed at the live hearing.

Let me first begin by stating that Senate Bill 1811 could well become one of the most important creative landmark programs in the field of water resources. It shows insight technologically, economically and managerially. It's clear that Senator Nickles considers water resources to be an area of primary interest and concern both to him and his constituents. Of course, in an effort to serve the nation in this area one is bound to make some mistakes and misjudgments. The solidity and excellence of Senate Bill 1811 is contrasted with the unfortunately, ill-conceived Senate Bill 2098 known as the Seward Project which Senator Nickles thought might improve the water supply program for the state of Oklahoma. Close scrutiny showed that S2098 would have a dramatically negative cost benefit ratio. The value of the water yielded did not come close to supporting its cost. The value of any flood control benefits was minimai. Realistically, the water supply demand in central Oklahoma could not justify the expenditure of \$270 million for the project. Thought well intended it would have been seen as another wrong headed, pork barrel water scheme. Happily educated opposition to the bill within Oklahoma, has caused Senator Nickels to withdraw it from future consideration.

Senator Nickles should in no way be condemned for bringing the item forward for public debate. Without debate nothing is accomplished and without "at bats" no significant number of hits can be recorded. Senate Bill 1811, the "High Plains States Groundwater Demonstration Program Act of 1983" is more than a hit for Senator Nickles. I foresee that in fact it will be a home run.

Water quality problems throughout the nation can frequently be blamed on mismanagement of clearly anticipated drought and flood cycles, where people continue to be surprised that we don't always receive "normal" rainfall year after year after year. Coordinated use of ground- and surface-water resources, on no more than a commonsense basis, can eliminate much of the world's periodic water shortages.

Unfortunately, rather than apply reasonable management techniques, we persist in doing endless battle with nature, never recognizing the futility of our effort. It would appear that we mistake nature's mindless beauty as an indication of her submission to our superior intelligence.

Poets extol nature "ever charming, ever new" but like other aggressors, she chooses to hide her true face. In her benign moods she may grant us an armistice with gentle rains and spring-time sun. Angered, she's more destructive than any weapon devised by man. We build along the seashore only to have that sea swallow the land. On California hillsides, nature's mudslides sweep away arrogant abodes.

We dam up the world's mighty rivers only to see our reservoirs fill with silt, our cement crack and our floodplains breed disease. Nature helps us ripen fields of grain until we grow self-satisfied; then, inconsistent, she withholds the rain, leaving barren plains or dust bowls.

We have on occasion won great victories over nature by divining her secrets, but we have never conquered her. More often than not, we work against nature rather than with her. She must laugh in the knowledge of the ease with which in time she overruns our efforts.

We cannot straighten rivers for long, expect reservoirs to remain empty, shorelines to stay gentle and sandy, slopes to sit upright or land to be ever fertile, but we try, oh how we try.

One day soon I hope the world will learn this lesson in our combat with the environment and recognize that success will come only when we learn to integrate our needs with the ebb and flow of our natural environment.

Ground water and the reservoirs in which it is stored hold the key to the efficient utilization of our water resources. We can no longer ignore the need to begin a well-managed effort to use conjunctively our ground- and surface-water resources through the mechanism of artificial ground-water recharge.

Active projects are being carried out currently in more than 20 countries including: Japan, USSR, Switzerland, Algeria, USA, Australia, Israel, Rumania, Bulgaria, France, Germany, Sweden, Egypt, The Netherlands, Tunisia, Togo, Senegal, Iran and Spain. Many of these have been going on for a quarter of a century.

In 1968 the United Nations began a major research project on the subject of artificial recharge that culminated in a 1975 report entitled "Ground-Water Storage and Artificial Recharge" which positively articulated the hope these techniques held for mankind.

Yet even with this attention from notable experts around the world, scientists and planners have not been sitting up and taking significant notice. Nation after nation throws up its hands in frustration over the dwindling availability of water to supply its ever-expanding population, yet it and its water-supply consultants do not adequately investigate ways to integrate

underground storage with highly variable surface-water supplies.

Throughout the world, where ground water is used heavily, water managers complain of falling water tables, water mining and inadequate natural replenishment, often desiring to limit further use. Yet they fail to recognize the storage space they have just made available for the surplus surface water which comes to them when Mother Nature sees fit to drown them in her fury rather than parch them with her arid ways.

Artificial recharge is a means of augmenting the natural infiltration of surface water into a ground-water reservoir. One may utilize a variety of methods, such as wells, pits and ponds, gravel drains, irrigation channels and spreading basins. The two major techniques of artificial recharge are surface spreading and injection wells. In surface spreading methods, large areas of land may be flooded, basins constructed, ditches or furrows excavated, or existing stream channels might be modified. Water is diverted into these catchment structures and allowed to infiltrate. Recharge or injection wells might consist of shallow, relatively large pits or shafts, or screened wells. Recharge wells and shafts permit direct access from the surface-water source to the ground-water reservoir.

Artificial ground-water recharge techniques have been used for a variety of purposes. These include:

- o Ground-water (well field) management.
- o Reduction of land subsidence.
- o Renovation of waste water.
- o Improvement of ground-water quality.
- o Storage of stream waters during periods of high or excessive flow.
- o Reduction of flood flows.
- o Increasing well yield.
- o Decreasing the size of areas needed for water-supply systems.
- o Reduction of salt-water intrusion or leakage of mineralized water.
- o Increasing stream flow.
- o Store fresh water, derived from rain and snowmelt.
If the existing ground water is saline, the less dense lens will float on the saline water.
- o Secondary recovery of oil.

The type of artificial recharge system that can be developed at any specific site is controlled, to a large degree, by the geologic and hydrologic conditions that exist at that site. Site selection criteria, in addition to economic consideration, include:

- o Source of recharge water.
- o Chemical and physical characteristics of recharge water.
- o A geologic formation having acceptable thickness, permeability and porosity to receive the design rates and volume of recharge water.
- o Thickness and permeability of the material overlying the

potential aquifer.

- o Chemical characteristics of native water in the aquifer matrix.
- o Retention time of recharged water in the aquifer.
- o Piezometric head in an underlying aquifer.
- o Topography.
- o Availability of property.

Availability of recharge water, either on a perennial or intermittent basis, is of prime concern in any recharge operation. In some areas, impoundment structures may be necessary for temporary surface storage.

The time has come for practical field hydrogeologists on every regional drainage basin, every river commission and water utility to study the potential of artificial ground-water recharge as a means to maximize their available water supply and enhance its capacity to conjunctively use, integrate and conserve existing ground- and surface-water sources.

We have no new water-supply crisis; we have simply found the time, place and space to rant about problems we previously ignored. No single solution exists to all problems, but all problems have a solution that exists on a list in the collective minds of this world's hydrologists. Many believe artificial ground-water recharge tops that list.

The High Plains area tapping the Ogallala is both the showplace of effective ground-water development and the ravaged desolation of overuse and poor management. Artificial recharge can be the primary savior of this area and will put man's needs in synchronization with nature. The two-step program of Senate Bill 1811 asks first for the design of a set of demonstration projects followed by the implementation of the best projects. It is very well thought out. The funding request is more than reasonable and the payback to the citizens of the area will be many times its cost. It will establish a low cost solution to so many of the water resource fears that besiege our citizens from coast to coast.



COMMENTS ON S. B. 1811

LADIES AND GENTLEMEN, I THANK YOU FOR THE OPPORTUNITY TO MAKE A FEW REMARKS REGARDING BILL S. 1811 THAT IS CURRENTLY BEFORE CONGRESS.

I REPRESENT HICKORY UNDERGROUND WATER CONSERVATION DISTRICT NO. 1 OF BRADY, TEXAS. WE ARE A NEWLY FORMED WATER DISTRICT, ORGANIZED BECAUSE OF INTENSE LOCAL INTEREST IN PRESERVING AND MANAGING THE ONLY POTABLE GROUND WATER SOURCE AVAILABLE - THE HICKORY SANDSTONE. THIS AQUIFER IS THE SOLE SOURCE FOR ALL USERS, PRINCIPALLY MUNICIPAL, FOR THE ENTIRE 1,250,000 ACRE AREA THAT LIES WITHIN PARTS OF 6 COUNTIES IN CENTRAL TEXAS, (CONCHO, KIMBLE, McCULLOUGH, MASON, MENARD, SAN SABA). TO SHOW HOW IMPORTANT THIS SOURCE OF WATER IS, RECENTLY 2 RURAL WATER SUPPLY DISTRICTS WERE FORMED IN AREAS THAT HAD TO HAUL AND STORE WATER IN EARTHEN TANKS FOR YEARS.

AT THIS POINT, THE COMPLETE HYDROLOGICAL BUDGET IS NOT KNOWN BECAUSE OF THE RELATIVELY RURAL NATURE OF THE AREA. HOWEVER, WE DO KNOW THAT THE AQUIFER DIPS STEEPLY TO THE NORTHWEST AND THE ONLY AREA EXPOSED TO THE SURFACE FOR RECHARGE IS ABOUT 15 MILES SOUTHEAST OF BRADY. ALSO THERE IS A STREAM THAT FLOWS OVER THE OUTCROP AREA.

FROM THE OUTSET OF THE DEVELOPMENT OF THE DISTRICT, ONE OF THE PREMIERE GOALS HAS BEEN DETERMINING THE POTENTIAL AND IMPLEMENTING AN OPERATIONAL RECHARGE PROJECT IN THE OUTCROP AREA TO INSURE THAT IT RECEIVES THE MUCH NEEDED TRANSFUSION OF THE PRECIOUS WATER NECESSARY FOR ALL INHABITANTS IN THIS CENTRAL TEXAS AREA. IF WE DRY UP THE HICKORY SANDSTONE, THE COST OF REPLACEMENT WATER IS ALMOST UNIMAGINABLE. TO SAY THE LEAST IT WOULD HAVE SEVERE NEGATIVE CONSEQUENCES THAT WOULD SERIOUSLY DISRUPT OUR LIVES.

THEREFORE, YOU CAN APPRECIATE THE DELIGHT SHARED BY ALL THOSE INVOLVED WITH THE DISTRICT TO LEARN OF S. 1811 INTRODUCED BY SEANTOR NICKLES. IT'S LIKE A DREAM COME TRUE. IF EVER THERE WAS A BILL TAILOR-MADE FOR HICKORY UNDERGROUND WATER CONSERVATION DISTRICT NO. 1, THIS SURELY IS IT. WE FEEL THROUGH THIS BILL A LITTLE HUMAN INGENUITY CAN BE APPLIED TO ASSIST MOTHER NATURE IN REPLENISHING OUR WATER TO INSURE A WATER SUPPLY FOR THE FUTURE. I WOULD LIKE TO GO ON RECORD AS VOICING A STRONG ENDORSEMENT FOR THIS BILL AND RECOMMEND THAT YOU WORK IN A MOST EXPEDITIOUS MANNER TO MOVE THIS BILL ALONG AND GET IT INTO LEGISLATION.

THANK YOU FOR YOUR TIME.

John D. Ke...

NATIONAL CENTER FOR GROUND WATER RESEARCH

A Consortium of Universities

UNIVERSITY OF OKLAHOMA

Dr. Larry W. Canter
200 Feagar Street
Norman, Oklahoma 73019

405-325-5202

OKLAHOMA STATE UNIVERSITY

Dr. Norman Durham
203 Whitehurst Hall
Stillwater, Oklahoma 74078

405-624-6368

RICE UNIVERSITY

Dr. Herb Ward
P.O. Box 1892
Houston, Texas 77001

713-527-4086

February 17, 1984

Senator Don Nickles
United States Senate

Dear Senator Nickles:

In the middle to late 1970's a new phenomenon in the environmental area started popping up all over this country. That phenomenon was ground water pollution. It had been known for years that our waste products had produced detrimental effects in the air we breathe and in our lakes, rivers, and streams. Almost overnight the nation was awakened to this new environmental phenomenon of ground water pollution. For years, soil scientists, agronomists and engineers believed that the soil possessed an infinite ability to retain and/or purify our waste streams. With alarming frequency ground water pollution episodes started receiving national attention and places such as Love Canal, Valley of the Drums, or Rocky Mountain Arsenal became household terms.

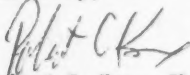
The reaction to this potential environmental nightmare by our governing legislative bodies was immediate. The comprehensive Environmental Response, Compensation and Liability Act of 1980, or "Superfund", was passed by Congress to deal with the many substantiated and potential hazards posed by uncontrolled hazardous waste sites. The U.S. Environmental Protection Agency established the National Center for Ground Water Research as a part of its Centers of Excellence program. In essence, there was a problem and we reacted to it. For the past 5 years, we at the National Center for Ground Water Research have been researching technologies for cleaning up existing ground water pollution and preventing future pollution.

On the other hand, it has been known for upwards of 30 years that withdrawals of ground water in the High Plains States were exceeding natural recharge rates and that water levels were dropping. It has also been known for many years that overpumping of ground water could lead to problems with land subsidence and saltwater intrusion. In spite of all this common knowledge as to the undesirable effects of excessive ground water withdrawals there has been relatively no interest in researching and rectifying the problem.

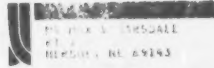
Senator Nickles
February 17, 1984
Page 2

There is a definite need for research concerning all facets of artificial recharge from technical feasibility to economic viability to demonstration projects. So Senator Nickles, the response of my colleagues at the National Center for Ground Water Research and I to your proposed legislation is; it is about time! We wholeheartedly support the bill.

Sincerely,

A handwritten signature in dark ink, appearing to read "R. C. Knox", written over the typed name.

Robert C. Knox, Ph.D.
Environmental Engineering Scientist



Hervey, Nebraska

Senator Don Nickles,
Republican- Oklahoma
Chairman of the Senate Energy & Natural Resources Sub-Committee

Dear Senator:

Regarding the "Ground Water Recharge Demonstration Bill"

Please consider the following before you carry out your sponsorship and have your committee put this bill before the full Senate.

1. Why are you putting an additional tax burden on the American taxpayer by adding another program on the Federal Level.
2. The Federal Government is broke, the taxpayer is also in critical financial condition. What are you going to use for money to carry out this new and additional federal program?
3. If water legislation and action is felt to be necessary and the tax payer feels he can afford it the proper place for such action is in the State legislatures.

When you consider such a project I suggest you call the following information to your sub-committee.

1. Water is not like coal and oil. This natural resource is not diminished in amount by use! Coal and oil change in chemical form and no longer exist when used. Water, if used to irrigate--poured back on the ground to return to the underground supply, drunk, used to bathe, turned to steam or evaporated it again condenses and returns to the earth, etc.-- There is no way to change the amount.
 2. Underground water or rainfall that flows in rivers to the ocean, the sea level does not rise, but the water returns to the area from whence it came by two means---rainfall -- or sea and the underground water seek the same level over the world and have stayed consistent since the earth was created.
- You realize there is only some 29per cent of land area in the world, rivers have been flowing to the oceans since time began, and the underground water and sea level have stayed consistent since time began. If you are a student of the Bible, a great source of knowledge, I suggest you read Ecclesiasted Chapter 1, verse 7.
3. Recharging the underground water is a dangerous action.

The only way man can alter the underground water table is to bring water from other areas such as streams or lakes, reservoirs etc. by ditch or pipe to raise the water table or/ and store it in an area where it seeps out or to apply it to the ground by irrigation. This a questionable act as the area on which such irrigation takes place or area which receives a recharge by seepage if high ground or hills has practically no benefit from the rise in the underground water table a simple added few feet of well pipe would not have economically taken care of. If the ground is fertile level farm ground the rise in the water table will cause the soil to turn alkaline. Water levels raised above their normal patterns cause salt deposits in the soil which will mean few plants will survive.

If you doubt this please note all areas of concentrated irrigation of farm land must have a drainage system to bring the water table back to normal. In Nebraska the building of the Sutherland Reservoir was a prime example of this. Farm land adjoining the north and east sides of the reservoir required four drainage ditches to be built to bring the water table back to its original level and preserve the surrounding farm land. *South of the North Platte River, fertile valley land.*

Nebraska water authorities have done a dismal job of handling the water projects, Lake McConahay, etc. and hundreds of acres of fertile farm land and homes have been flooded in 1983 and face the same problem in 1984. I suggest what we need is no more federally mandated projects and if there is a need for such action it be on the state level where we can control it.

4-- We and you have been told the Ogallala aquifer is being used up and unless we conserve we will be out of water in the year of 2,000. As we have testified water can not be used up and water tables are not changed by use of water which is used in the area from which it is pumped. However water tables do rise and fall. There are two variables which cause this. Above or below normal rainfall, and above or below temperatures and winds. The rainfall and temperatures are balanced in nature creating evaporation and rainfall patterns which when called normal for the area create a consistent normal water table. When above or below normal conditions occur we find the water table rises or falls causing a disaster, a good year, or just a normal year. This variation is not controlled by man and I suggest you do not create a program or make an appropriation in an effort to do so.

5. Variation of water table has been a condition which has created problems for farmers and residents of cities for many years because of nature long before man started to use water for irrigation and industrial uses we have today and the people realized nature caused the problem and adjusted to handle the problem on the local level.

Senator please concentrate on cutting SPENDING AND GOVERNMENT before our system collapses. Government cannot finance many of the necessary things today and many unnecessary inadvisable things they are doing---and you are suggesting we add another unnecessary and ridiculous program.

I realize the bill was originated by a Nebraska Congressman, Beurter but knowing him personally as he served many years in our State legislature---his major in college and his occupation as a teacher in College was---Government Planning. He saddled Nebraska with several new, expensive and unnecessary tax demanding programs. I apologize to you for Nebraska's ignorance for sending him to Congress.

Please

Map Vandersee

A 30 year Nebraska Farmer.

When first I heard of the creation of the North Platte River
I was raised and created an alkali
condition which completely destroyed black
growth in the early 1920's. Drainage
districts were created which show heavy
streams during the irrigation season. Both
the water and back to normal areas. Both
in areas where they were possible & it is
one of the highest producing farm areas in
Nebraska. There are a few isolated areas
where due to terrain areas are still
possible and these areas are still
covered with white alkali & totally worthless.
Some such areas have a coarse short alkali
grass not very productive back here
in the north Platte & South
Platte river valley. It is surrounded

CCWCD

**central colorado water
conservancy district**

2308 29th St. Suite 2 Greeley, Colorado 80631
Phone: 330-4540 Metro Phone: 825-0474

February 8, 1984

Senator Don Nickles
Senate Subcommittee on Water and Power
Committee on Energy and Natural Resources
Room 212
Hart Senate Office Building
Washington, D.C. 20510

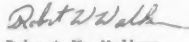
Dear Senator Nickles:

The Board of Directors of the Central Colorado Water Conservancy District is actively involved in surface and ground water storage in the South Platte River Basin in Colorado. Irrigators in northeast Colorado have worked for generations to store water during periods of high runoff for use during the dry summer months.

The need for underground recharge of excess surface waters in Colorado is great. Areas in northeast and eastern Colorado are experiencing alarming declines in ground water levels, and are requiring immediate action on the local, state, and federal levels.

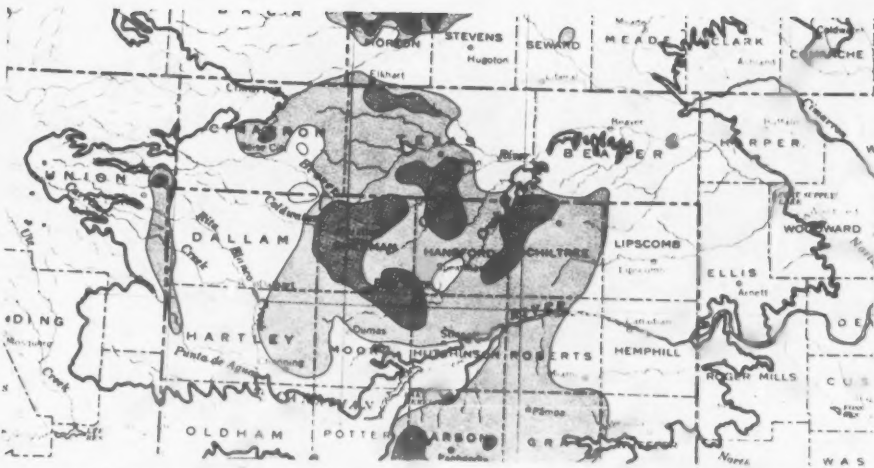
Therefore, we urge the Senate Subcommittee on Water and Power to support the actions proposed in House Resolution 71 and Senate Bill 1811. The future of all Coloradoans will be enhanced through this legislation which will significantly improve water availability in our semi-arid state.

Sincerely,

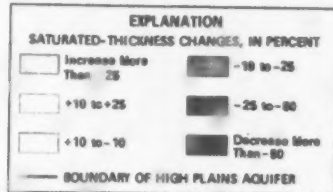
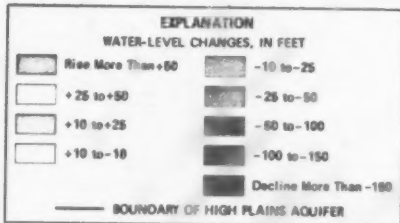

Robert W. Walker
President

RWW/sam

cc: Congressman Hank Brown
Senator Bill Armstrong
Senator Gary Hart



SATURATED THICKNESS CHANGES
Predevelopment to 1980



Maps courtesy U.S. Geological Survey
HA-652

WATER LEVEL CHANGES
Predevelopment to 1980



This publication, printed by Journal Record Publishing Co., Oklahoma City, is issued by the Oklahoma Water Resources Board as authorized by James R. Barnett, Executive Director. Five thousand copies have been prepared at a cost to the taxpayers of the State of Oklahoma of \$490.00.

WATER LEVEL AND SATURATED THICKNESS CHANGES IN THE OGALLALA AQUIFER IN THE HIGH PLAINS OF OKLAHOMA

Predevelopment to 1980

Beneath parts of nine western Oklahoma counties and eight states lies the enormous Ogallala ground water aquifer, a resource which has made the agricultural region one of the most productive in the world through its use for irrigation.

In response to concern that continued pumping for crop cultivation might eventually exhaust the water supplies, Congress in 1976 authorized a study to assess the depletion of natural resources in the High Plains. To accomplish the intent of Congress, six states of the High Plains—Ogallala Region—Oklahoma, Texas, New Mexico, Colorado, Kansas and Nebraska—formed the High Plains Study Council. The Oklahoma Water Resources Board was designated as the state's lead agency in accomplishing Oklahoma's portion of the study.

As the work draws to a close, it brings with it a better understanding of the resource and a wealth of data that will serve as the basis for recommendations to Congress.

WATER LEVEL CHANGES

The Ogallala aquifer in Oklahoma covers approximately 7,350 square miles. Since irrigation began in the late 1930's and early 1940's, approximately two percent of the area has registered water level declines of 50 to 100 feet; 10 percent, declines of 25 to 50 feet; 29 percent, declines of 10 to 25 feet; 36 percent, changes ranging from rises of 10 feet to declines of 10 feet; and about three percent, rises of 10 to 25 feet.

The map on the reverse side illustrates the areal extent of water level changes that occurred from predevelopment to 1980 in the Oklahoma part to the Ogallala aquifer. This map was constructed by superimposing maps of predevelopment and 1980 water levels and connecting points of equal water level change. Each

interval on the map shows the range of change that predominates in that area. Because of map scale, it is not possible to show small exceptional areas within each interval.

Predevelopment water level data were collected prior to significant development of irrigation wells in the High Plains. Development generally progressed northward from New Mexico and Texas during the 1930's, and to Oklahoma and Kansas during the 1940's.

Before irrigation development, the High Plains ground water system was in a state of dynamic equilibrium, with long-term recharge equal to long-term discharge. In many parts of the High Plains, natural equilibrium was significantly modified by one of the following activities: (1) development of irrigation wells that increased discharge and removed large quantities of water from the aquifer; (2) changes in land management that affected the amount of recharge the aquifer received from precipitation. These activities cause water levels either to rise or decline as the system seeks to reestablish equilibrium between recharge and discharge.

In most areas irrigated in the High Plains, ground water is being mined; that is, more water is removed annually from storage than is replaced by recharge. As a result, water levels in these areas are declining.

The largest area of water level decline exceeding 100 feet occurs south of Guymon in Texas County. Small, scattered rises in Beaver, Texas and Cimarron Counties are attributed to recovery from abnormally low water levels during the great drought of 1933-1940.

SATURATED THICKNESS CHANGES

The aquifer in Oklahoma originally held approximately 97.8 million acre-feet of water in storage prior to irrigation development. In 1980, the quantity estimated remaining in storage was 91 million acre-feet, a change of 6.8 million acre-feet or a seven percent reduction in storage.

The map on the reverse side illustrates the areal extent of saturated thickness changes (in percent) that occurred from predevelopment to 1980 in the Oklahoma section of the Ogallala

aquifer. The map was constructed by superimposing the 1980 saturated thickness map and the predevelopment map to 1980 water level change in saturated thickness. Each saturated thickness change interval on the map shows the range of change that predominates in that area. Again, scale prohibits showing small, exceptional areas within each interval.

The saturated thickness map depicts area of change in available water supply caused by pumping and appears somewhat similar to the water level change map.

Areas with small predevelopment water level changes may show a large percentage change in saturated thickness due to thinner saturated layers. For example, a water level decline of 10 feet in an area where predevelopment saturated thickness was 200 feet represents a change of only five percent, while a decline of 10 feet in an area where original saturated thickness was 30 feet represents a change of 33 percent. Changes in saturated thickness may be directly related to changes in well yield.

Areas of significant decreases in saturated thickness generally are found where the aquifer has been pumped longest for irrigation, such as areas south of the Canadian River in Texas and New Mexico where development since the 1930's reduced the saturated thickness over half the region by 25 percent. Decreases of 25 to 50 percent occurred between the Canadian River and the Kansas-Oklahoma border, and decreases in saturated thickness exceeding 25 percent were recorded in Beaver, Cimarron and Texas Counties. An exceptional 10 percent increase occurred in one area of Cimarron County.

CONCLUSIONS

The information provided here is intended to apprise farmers, civic leaders and local, state and federal planners of the declining water levels in the Ogallala ground water aquifer. So informed, citizens of the High Plains, along with policy-makers, may cooperate in the design of a sound orderly, long-range strategy for conserving and managing the water supplies of the productive High Plains Region.

DATE ANS:-----	DOC #:-----
AIDE:-----	REC #:-----
CATS:-----	
PARA:-----	
FILL INS:-----	

February 28, 1984

Russell R. Brown
Professional Staff
Committee on Energy and Natural Resources
SD-360 Dirdson Building
Washington, D.C. 20510

Dear Mr. Brown:

I would appreciate this letter being included in the record of the Subcommittee on Water and Power hearing held in Woodward, Oklahoma by the Honorable Senator Nickles. On behalf of the Pioneer Irrigation Districts of Colorado and Nebraska, Mr. Saunders gave oral testimony on the 17th of February for the Senators benefit expressing our support for S.1811.

With the continued depletion of the Ogallala Aquifer the springs are ceasing to flow, therefore the surface waters are receding, thus making irrigation under these surface rights limited. Irrigation under this particular surface right out of the North Fork of the Republican River have been in existence since 1888.

The Districts have participated in a multitude of studies to possibly assist the District of this problem. We have cooperated with the Soil Conservation Districts to examine off season surface storage of the Republican River waters. We have lined the supply ditch with concrete to salvage seepage waters and made more efficient use of the available waters.

We have spent considerable money in litigation to attempt having the State Engineer of Colorado assist in our problem by having the junior irrigation wells contribute water or assistance to our cause, but to date without any satisfaction.

We are presently conducting a hydrological study of the entire Republican River in the efforts in obtaining the necessary waters for us to remain in irrigated business.

Russell R. Brown
February 28, 1984
Page #2

As can be determined from the above the Pioneer Irrigation District is very much in support of the Honorable Senator Nickles efforts in the passage of S. 1811 and will assist the committee in every effort possible.

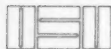
By a copy of this letter to Senator Hart and Senator Armstrong of Colorado we are urging them to support this effort also and vote in favor of the bill at the appropriate opportunity.

Sincerely,

Pioneer Irrigation District of
Colorado and Nebraska
by

Ashton Wilson - President
Box 306
Laird, CO 80739
Ashton Wilson
cc: Mr. Billy E. Martin

Pioneer Irrigation District
P. O. Box 306
Laird, CO 80739



Oklahoma State University

GRADUATE COLLEGE

STILLWATER, OKLAHOMA 74078
WHITEHURST 202
(405) 624-6368

February 21, 1984

Senator Don Nickles
215 Dean McGee Ave., Rm. 820
Oklahoma City, OK 73102

Dear Senator Nickles:

I had the pleasure of attending the hearing you held for the Ground-Water Recharge Bill in Woodward, OK, on February 17. After all the testimony, I want to take this opportunity to introduce a variable that was not discussed at that session. Numerous scientists and recent reports have predicted that the "Greenhouse effect" (an increase in atmospheric carbon dioxide) will have a major impact on climate by the middle of the 21st century. If this global event occurs, the impact on the Great Plains, perhaps a major increase in average temperature and a decrease in average precipitation, will create further stress on the Ogallala aquifer.

I would like to suggest that models for the prediction of water usage and levels of the aquifer incorporate major atmospheric changes as a result of the "greenhouse effect". Research must not ignore the atmospheric components of the hydrologic cycle. Plans for aquifer recharge may be useless if climatic changes are ignored. With the passage of your bill, I hope that you will add meteorologists and climatologists to the team(s) of scientists who will perform the research.

As several people testified, the key issue related to water use will be economics. Major climatic changes could initiate the need for more water from the ground water supply, thereby requiring a greater use of energy. Interaction of all variables in the research models may provide possible solutions for the water crises in the Great Plains.

Sincerely yours,

John D. Vitek
Assistant Dean

JDV/sw

